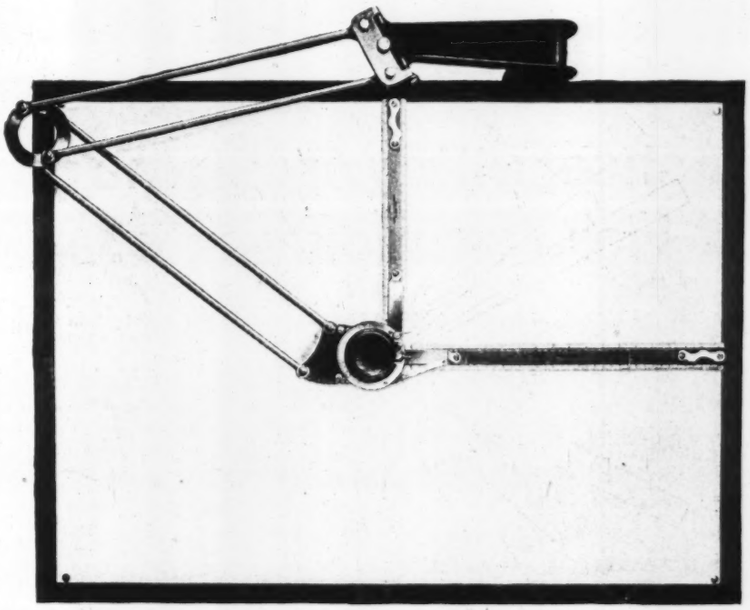
Engineering News

Issued Every Thursday. Hill Publishing Company. NEW YORK, JANUARY 23, 1913. Price, 15 cents. $6 yearly. To Canada $7. Foreign $8.



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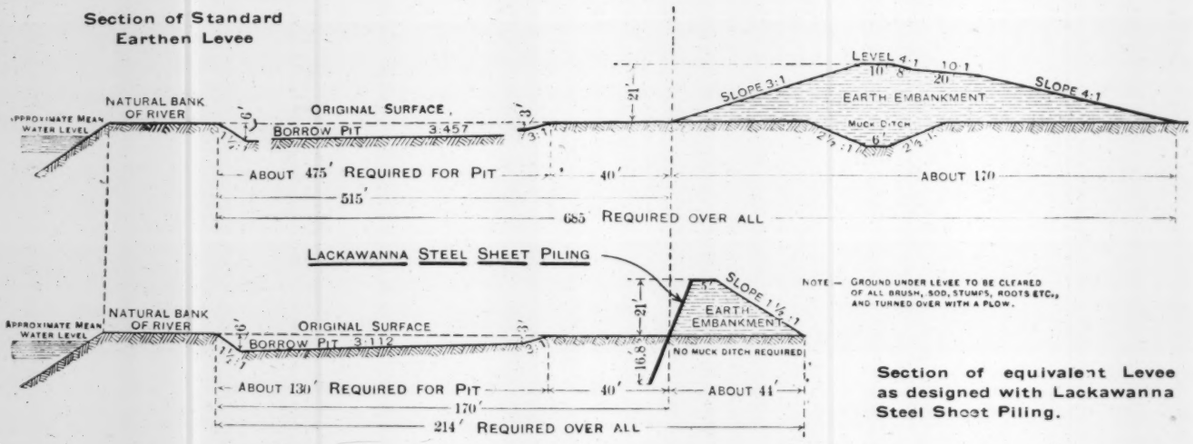

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Engineering News

CHARLES WHITING BAKER, *Editor*

Subscriptions payable in advance, $5.00 a year for 52 numbers, including postage in the United States, Mexico, Cuba, Porto Rico, Hawaii, or the Philippines, $7.50 in Canada.

Published Weekly By HILL PUBLISHING COMPANY
505 Pearl Street, New York City

JOHN A. HILL, Pres. ROB'T MCKEAN, Sec'y.
Cable Address: "ENGNEWS"

To foreign countries, including postage, $9.00 or its equivalent, 36 shillings; 36 marks; or 45 francs. Notice to discontinue should be written to the New York Office in every instance. Advertising copy should reach New York Office by Thursday of week before date of issue. Entered at New York Post-office as mail matter of the second class.

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What The Buyer Needs To Know

Number Four

We are an apathetic lot.

That is to say, we all of us have a certain quality of human inertia which tends to keep us immovable.

We do new things under protest—veritably howling if we are asked to adopt a new system, a novel idea, another method or a change of base.

This inability to fully live up to and grasp our opportunities is an element of human nature that balks progress at every step.

We proudly label ourselves "up-to-date"—and then back water hard if anybody tries to interest us in a new invention or improved device for getting better results in our work.

Sir Henry Bessemer had to first convert iron into steel and then convert skeptics into believers. Bell fought opposition left, right and center to get his telephone financed. Cyrus Field laid the Atlantic Cable amid the jeers and hoots of all nations. The astute Napoleon "turned down" Robert Fulton's steam propelled vessel—and lost a wonderful opportunity to invade England.

It is to overcome this human inertia that salesmanship and advertising—which is but printed salesmanship—came into exixtence.

If they are persistent and aggressive it is because they have a tremendous job before them and nothing but persistency and aggressiveness will win the fight.

We ofttimes complain of these things without realizing that they keep business at high water mark and make work for us all. For without the aggressive salesman and his forerunner Advertising, business would slump to a dead level of dulness.

Without them to literally *force* us into action we would fall behind in the race.

A homely illustration of a man "forced" into doing what was good for him to do occurred in New York City a few days since.

A little tailor's assistant on the East Side decided that his long hours of labor were not compensated for by the short terms of his weekly wage. This view of things grew upon him the faster as he saw men of his own age about him flashily attired, with apparently much leisure time and substantial resources.

He knew that they were crooks and it occurred to him that they had solved the problem of the higher cost of living.

So, one Saturday night he turned his back upon honest—but poorly paid—labor and invested the meagre contents of his pay envelope in a burglar's outfit.

He began his studies in the economics of easy money by breaking into a Second Avenue haberdasher's shop. Getting in was so easy that he wondered why he had ever wasted time at a tailor's bench.

Just at this stage of his conjecture he was nabbed by the police. Breaking in had set off a newly installed burglar alarm.

Now, the sad little story of the tailor's downfall does not interest us as much as the story of the haberdasher who took a stitch in time to save nine.

He had been five years installing that burglar alarm! Five years of persistent and aggressive advertising and salesmanship to save him from loss!

He had been cajoled, driven, plead with, sworn at, coaxed, bamboozled at different stages of the game until, at last, he backed out of his own light and bought.

As a matter of fact he bought on a gamble. Life insurance is bought on a certainty—sooner or later the Grim Reaper comes, yet life insurance is one of the hardest things to sell. But a burglar alarm only makes good *if* somebody attempts burglary. In this case its price was saved several hundred times over.

The manufacturer of machinery, equipment or supplies in the construction field offers a definite and tangible something to increase efficiency or reduce costs. The one who advertises his product makes certain claims out in the open.

If there be a moral to the foregoing it is that it pays to investigate those claims and apply them to your own problem—*before the tailor's assistant gets busy.*

Engineering News

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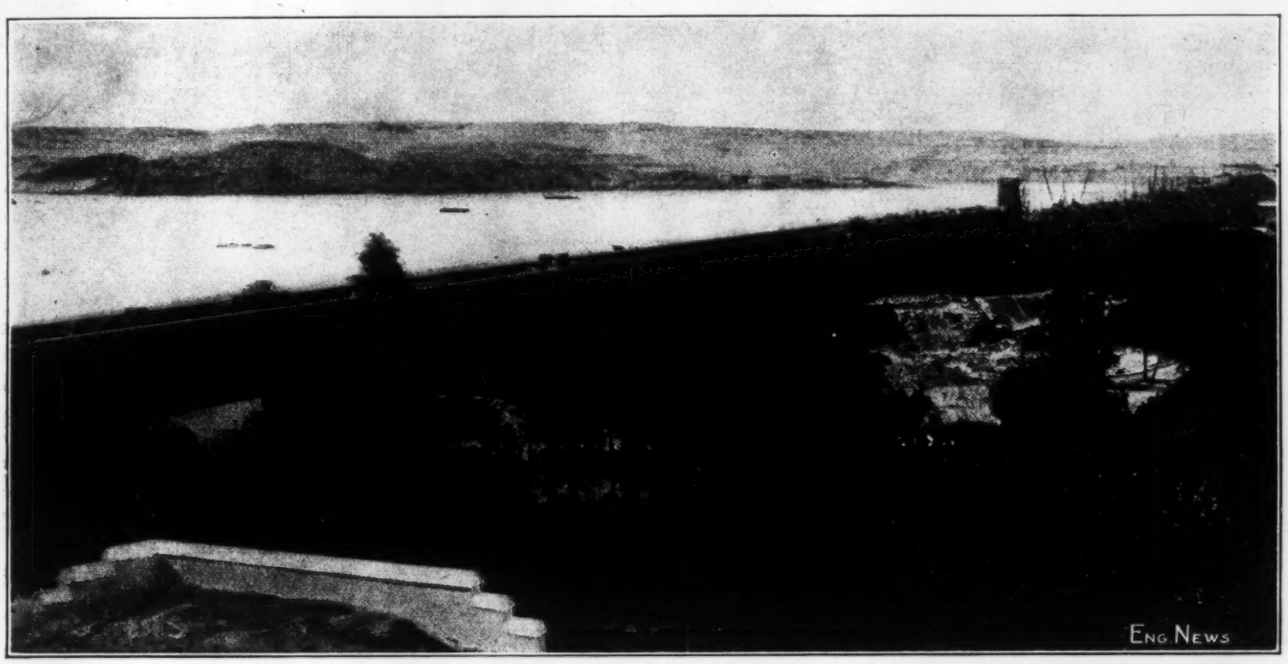
Completion of the Rebuilt Assuan Dam

We have already briefly noted the formal acceptance, on Dec. 23, 1912, of the rebuilt Assuan Dam across the River Nile, in Egypt.* It will be recalled that the old dam was constructed to make more effective the irrigation of the land in districts contiguous to the Nile. This was work on which the prosperity of the whole country depended, since the land had fallen desolate through the decay of the great ancient irrigation works—a decline which was only slightly improved by attempts of the ruler, Mehemet Ali, to convert part of the country from basin to perennial irrigation on a large scale and to introduce cotton growing. The proposal to create this dam, of course, aroused a popular clamor stimulated by the archæologists. As a concession to this sentiment, the Egyptian government decided that the water level of the projected reservoir should not be raised more than 350 ft. above the sea. This limited the reservoir capacity to 35,300 million cubic feet, but the designer, Sir Wm. Willcocks, devised a dam which he believed would allow the crest to be raised safely 19 ft. 9½ in. at a future date, if such a step should finally be permitted. The work was commenced in 1898 and completed in 1902, a year ahead of time, with Messrs. John Aird & Co. as contractors.

The dam was built of the red Assuan granite, laid in portland-cement mortar. One part of the length is of solid gravity section and the other of "pierced" section, to permit the rapid discharge of the silt-bearing flood waters before the burden could be deposited in the reservoir.

It was found, shortly after the first dam was put into use, that the development of the irrigated land could not go forward as desired with original height. After much study it was finally decided to raise the water level 23 ft. more, which was done by raising the masonry crest 16.4 ft. and thickening the dam 16.4 ft. In this way the capacity was increased to 81,190 million cubic feet, at an estimated cost of $6,000,000.†



DOWNSTREAM SIDE OF THE REBUILT ASSUAN DAM, NEARING COMPLETION
(From London "Engineering," Dec. 20, 1912.)

As shown in our previous article, the work of reconstructing the dam comprised three main operations: (1) thickening the present dam by the addition of a masonry reinforcement on the downstream face, (2) bonding this new work homogeneously with the original dam, (3) building the whole structure up to a desired height and making necessary changes in the locks and navigation channel of the Nile. The new masonry, which was built up in front of the old, was supported from 2 to 6 in. away from the latter by 1¼-in. steel rods a meter apart. This space was divided up into bays or compartments in which

*See Eng. News, Sept. 30, 1909, for a description of work then in progress. For articles on the old Assuan Dam, see Eng. News, Dec. 28, 1899, p. 418; Sept. 26, 1901, p. 221; Aug. 15, 1902, p. 106.

†See an article entitled "Egyptian Irrigation and the Assuan Dam," in London "Engineering," Dec. 20, 1912, for a history of the project connected with this development. From that article the progress of the work between 1909 and date has here been summarized.

perforated pipes were left for the introduction of cement grout when the temperature of the old and new masses of masonry should become equalized so that they could be bonded without danger of temperature stresses.

The grouting was begun in November, 1909, on parts finished two years before, and the work was completed in the season of 1911-12. The mixers were driven by portable engines and the grout put into the spaces by flexible piping. No trouble was experienced in the work, except that the men had to be trained to it, and it took longer than was expected.

The sluice openings in the new section are slightly higher than in the old one. The sides and floor, however, in both sections are flush. Thirty of the lower

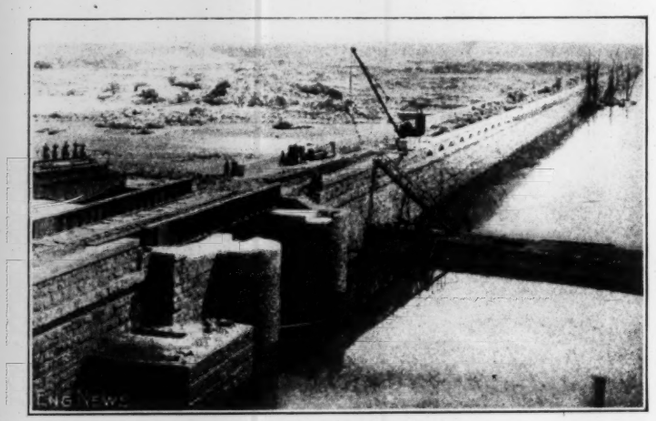


FIG. 2. UPSTREAM ENTRANCE TO THE ASSUAN DAM LOCKS
(From London "Engineering," Dec. 20, 1912)

sluices in the old dam had been lined with cast iron to expedite the work, but in the new section no such lining was employed. In the original dam no spillway was provided, but this has been done in the reconstruction. In that length of the dam where there are no sluices, the arched spillways are carried through the crest wall, as shown in Figs. 1 and 2.

The heightening of the dam entailed raising the walls of Lock No. 1 by 16.4 ft.; No. 2, 13.1 ft.; No. 3, 13.1 ft.; No. 4, 19.7 ft., and adding a new lock (No. 5) at the lower end of the flight. New gates had to be provided for Lock No. 1, and the old gates were shifted.

The gates used here are an unusual single-leaf sliding type. Each is suspended from a carriage running on a roller track at 90° to the lock, partly carried on the lock wall and partly on a bascule bridge. In the land side of the lock wall is a recess into which the gate is run when lifted out of its pockets. The upper locks are now very deep and the highest gates have to be 78 ft. 9 in. from top to bottom, for a width of opening only 32 ft. 2 in. The other gates of the channel, however, are 59 ft., 52 ft. 6 in., 45 ft. 11 in. and 36 ft. 1 in., respectively.

The old No. 1 gate was moved into No. 3 recess (Lock No. 2) and the old No. 2 gate was cut down for recess No. 4 (Lock No. 3). Old No. 3 gate was removed to No. 5 recess without alteration, and No. 4 gate was placed in No. 6 recess. The old No. 5 gate, which was 26 ft. 3 in. in height, was dismantled and used in the reconstruction work.

To transfer all of these gates it was necessary to stop traffic in the locks from December, 1909, to December, 1910. The No. 5 gate, which weighed 42 tons, was removed from its recess, divided in two parts and taken to the upstream end of the locks, where it was floated to the entrance and here used to dam back the autumn floods (Fig. 3), its height being increased by balks. After this gate was secured in place, those which had to be removed to new positions were run out on their bascules, jacked up and disconnected from the carriage and after being fitted with their new appurtenances were lowered upon two special trucks carrying cup centers. One track was laid on an arc so that the gate could be swung around 90° and pointed down the lock. When this position had been reached the tracks were relaid as a single tangent down the lock and each gate was pushed along 175 yd. When a lock sill was reached the track was run ahead into the

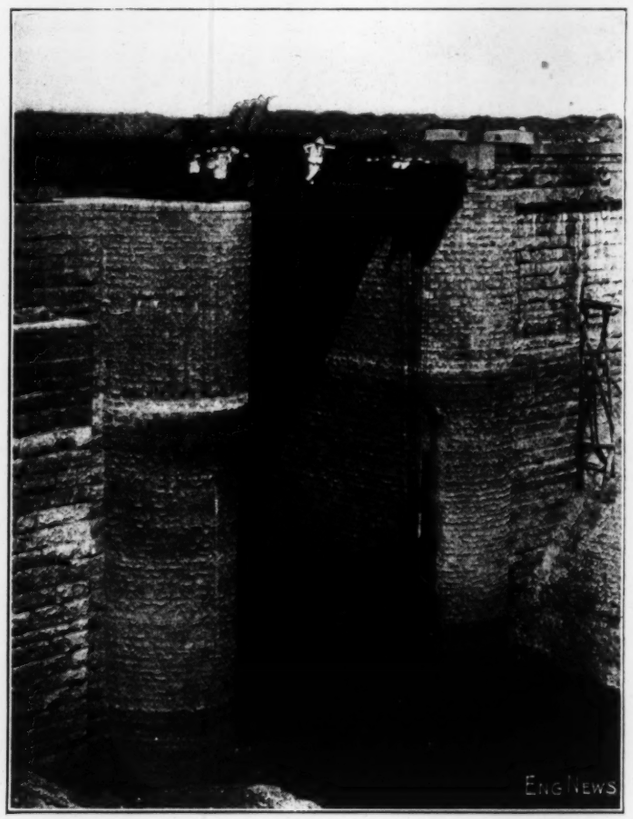


FIG. 3. REMOVING THE TEMPORARY GATE AT THE LOCK ENTRANCE OF THE ASSUAN DAM NAVIGATION CHANNEL
(Photograph from Underwood & Underwood, New York City)

next lock on piled timbers, which were gradually removed when the gate was clear of the sill and the track and gate lowered to the new level. When the proper recess was reached for each gate this process was reversed and the gate was fitted to its carriage on the bascule. The tallest gate thus transported weighed 92 tons and was steadied at the top by guy ropes.

How to Make Three Billion Dollars Look Like Thirty Dollars was shown by the Treasury Department the other day when it sent out word that Uncle Sam had $3,350,727,580 in circulation on Jan. 2, 1913, but added that estimating the population of Continental United States at 96,496,000, this was a per capita average of $34.72. Those who had less than that amount in their pocket at that time should remember that the statement covered money in bank reserves and in the treasuries of corporations as well as the contents of private pocketbooks and purses.

The Proposed Port of Richmond, Calif., in San Francisco Bay

A new port in San Francisco Bay is proposed in a recently printed report made to the Council of the City of Richmond, Calif., by the firm of Haviland & Tibbetts, engineers, of San Francisco. This report is printed in a 230-pp. book, with numerous drawings and illustrations. The City of Richmond is a comparatively new settlement, having been founded in 1900, and is located northeast of San Francisco across the bay. It is the terminus of two large railroads, and the seat of a number of extensive manufacturing interests. Apparently its future growth promises to be very rapid. With a view toward the increased commerce expected after the opening of the Panama Canal, the city has started this investigation toward the establishment of a large port, which can compete with the numerous other enormous port projects now incubating on the Pacific Coast.

The report takes up in general harbor and terminal developments now existing and proposed in San Francisco Bay, and then given a general description of Richmond, of the topographical features first, and the commercial development next, and finally outlines the proposed harbor improvements. The recommendations of the engineers in brief are as follows:

An ultimate development to be reached in a number of years is first proposed. In this it is recommended that a comprehensive plan be at once adopted for the orderly development of the harbor, as generally provided by the government plan, in order that all work performed may be a useful and integral part of the final scheme. This plan provides for the construction of a bulkhead wharf and eleven deep-water piers, 160x750 ft., separated by 300-ft. slips, all in the outer division of the harbor. Twenty-one piers, each 160x600 ft. and separated by 300-ft. slips, are provided along the interior basin. All the harbor is to be designed for 30 ft. of water at low tide. A belt-line railway and a 50-ft. highway are provided around the harbor passing along the rear edge of all wharves. It is further proposed that the city acquire all the submerged lands which were reclaimed by the dredging of the harbor, and reclaim and develop such land for manufacturing and industrial purposes. This project as outlined will provide the city with about 600 acres of reclaimed land for industrial and manufacturing purposes, and with a total of about 9.8 miles of waterfront, which it is estimated is sufficient to provide for an annual commerce nearly equal to that of San Francisco at present. The ultimate cost of this entire project is estimated to be over $18,000,000.

A development which can be immediately started is next proposed. This recommends that wharf construction be commenced simultaneously at both outer and inner ends of the proposed government harbor. The outer wharf when complete is to consist of a bulkhead wharf about 800 ft. long and 90 ft. wide. The outer 550 ft. of this is to be constructed at the present time. It is to be designed for the accommodation of deep-water ships, and as a convenient port of call for river traffic. An inner wharf 535 ft. long is also proposed. It is noteworthy that both wharves are designed to be of permanent and substantial construction, fireproof throughout, and of pleasing architectural appearance. Mechanical freight-handling devices have also been designed.

The engineers recommend that the city should immediately acquire sufficient submerged land around the edges of the government project to receive the material dredged from the channel. It should also acquire submerged land for rights-of-way for the government dike and training wall, and should cede this land to the government prior to the beginning of construction. The total amount of land required for both these purposes is about 802 acres. An estimate of this immediate project is about $729,000.

The report is now in the hands of the City Council of Richmond, but no action upon it has been taken as yet.

❋

Electric Traction on Steam Roads entering the city of Melbourne, Australia, has been estimated upon by various manufacturers about the world in response to invitations sent out six months ago, and the compiled figures have recently been printed in English technical journals. In 1908 the question of this substitution of electricity for steam was reported on by Charles Merz, but the local railway commissioners did not feel convinced that electrification would pay or that estimates of traffic increase would be realized. However, the estimates have now been exceeded. In 1908 there were 70,000,000 suburban passengers, and in this year there will be 90,000,000. In 1917, after electrification, it is estimated that there will be 150,000,000.

In the earlier report the direct-current system was recommended in preference to single-phase, and the commissioners have felt that today the direct-current system at higher voltage, employing an overhead wire, compares still more favorably with the single-phase. But as between $10,000,000 and $15,000,000 is involved in the conversion of some 300 miles of track, the government decided to secure complete alternative proposals on both systems, the specifications being drawn up by their engineers, Messrs. Merz & McLellan. Pains were taken, it is claimed, to see that the rival schemes were really comparable.

The cost of converting the suburban lines amounts to $11,750,000 and $15,300,000, respectively, for direct and single phase systems on the basis of the best tenders for each scheme. This includes items of capital expenditure affected by the different systems, such as steam raising plants, buildings of power house, repair shops, etc., are not included. The details are as in the following table:

	Direct-current system	Single-phase system
Power plant	$1,345,535	$1,440,220
High tension transmission	839,315	656,915
Substations	1,893,025	209,525
Electrical way equipment	2,811,400	2,059,580
Alterations to works and way	121,750	1,032,160
Rolling stock	4,736,160	9,886,720
Total	$11,747,185	$15,285,120

In comparing annual cost of operation under the two systems, only items were included in the report, which vary according to the system employed. These are shown in the following:

	Direct-current system	Single-phase system
Variable power house charges	$248,500	$292,000
Inspection and maintenance of lines, substations and tracks	168,485	110,800
Maintenance rolling stock	334,000	609,500
Interest on capital	469,885	611,405
Total	$1,270,870	$1,623,705

It was recognized that the single-phase system has proved more desirable for longer country lines in sparce territory. Therefore, the comparisons which were compiled of cost for the Melbourne-Bendigo line, which has a route length of 100 miles. The figures were $4,291,000 for the direct-current and $4,355,000 for the single-phase system, respectively.

These figures have been variously attacked as not being directly comparable. For instance, experience on the Brighton Ry. (single-phase) has led to the claims that (1) the figure for altering telephone and telegraph wires is $500,000 too heavy, and that the cost of the 500 single-phase motor-car equipments is much too high; in regard to operating costs, it is contended that (1) the Brighton experience indicates that the direct current losses due to converter substations would more than offset the increased energy consumption of the single-phase motors and (2) the maintenance of the direct-current overhead lines would be far greater than the single-phase on account of the heavier currents drawn.

Construction of the Calumet-Sag Canal

By E. J. Kelly*

SYNOPSIS—The Chicago main drainage canal, opened on Jan. 2, 1900, was built for the disposal of the city's sewage by dilution and for the elimination of sewage-pollution of the city's water supply, and incidentally with a view to its possibilities as an inland waterway. With the development of population in the outlying districts it has been necessary to provide for bringing the sewage of these districts to the main canal by means of branches having connections with Lake Michigan to give the necessary water for dilution. The North-Shore Channel is completed and in service. The Calumet Channel was put under construction during 1912, and this work is described in the article below. The main drainage canal was of importance not only as an engineering work but also on account of the numerous types and elaborate equipment of the plants for excavating and removing the material. The Calumet Channel being smaller, requires less extensive plant, but it is worth noting that much of the excavation is being done with drag-line scraper-bucket excavators, a type of machine practically unknown when the main canal was built. It is of interest to note also that some of these excavators are operated by electricity instead of by steam.

The Calumet-Sag Canal or drainage channel is now being constructed by the Sanitary District of Chicago to connect the Little Calumet River (and Lake Michigan) with the Chicago Main Drainage Canal. The purpose of this new canal is to intercept the sewage of that part of the Sanitary District lying south of 87th St., which now enters Lake Michigan through the Calumet River, and to divert it westward into the Main Drainage Canal. The canal bears westerly from the mouth of Stony Creek through a natural valley for a distance of about 16 miles, passing through the city of Blue Island, Ill., and entering the main canal at Sag Bridge, as shown in Fig. 1.† The total estimated cost of the entire project, including some work of improving the Little Calumet River, constructing controlling works, pumping station, intercepting sewers, etc., is $11,000,000.

The construction of the east and west ends of the canal is facilitated by the fact that the ground is fairly high and dry, but the middle portion lies in a swamp some 5½ miles long and varying in width from ¼ to ½ mile. This renders the excavation of this portion somewhat more difficult, presenting the problem of handling a large amount of surface water at practically all times while the work is under way.

Materials to be Excavated

The material to be removed has been classified under the two general heads of "glacial drift" and "solid rock," and unit prices are paid on this basis. Glacial drift is is described as comprising "all material that overlies the solid, stratified limestone rock in its original bed." Solid rock comprises "all stratified limestone found in its original bed." The general character of the material encountered at the east and west ends of the canal differs widely from that found in the portion through the swamps. In the former, black soil is found, 2 to 4 ft. deep, followed by sandy clay varying in depth from 2 to 6 ft., below this is encountered hard, white clay, gravel, boulders, some sea shells and other calcareous deposits, to a depth of 3 to 5 ft. and usually just overlying the solid rock. In some cases, however, a thin layer of shell limestone, or ledge rock is found overlying the solid rock. The average rock cut at the west end varies from 15 to 25 ft. while at the east end the borings indicate a rock cut somewhat less than this. The average total depth of the excavation is about 40 ft. Through the swampy portion, extensive peat beds and decayed vegetable matter are encountered, extending from the surface to a depth of 3 to 15 ft. below this a layer of silty clay of very unstable character (known locally as "bull liver"), varying in depth from 3 to 8 ft., is usually found; and underneath this a stratum of very hard clay, cemented gravel, and boulders, generally overlies the solid rock. Through the swamp the rock cutting varies from about 15 ft. to nothing, and the average total depth of excavation is about 35 ft.

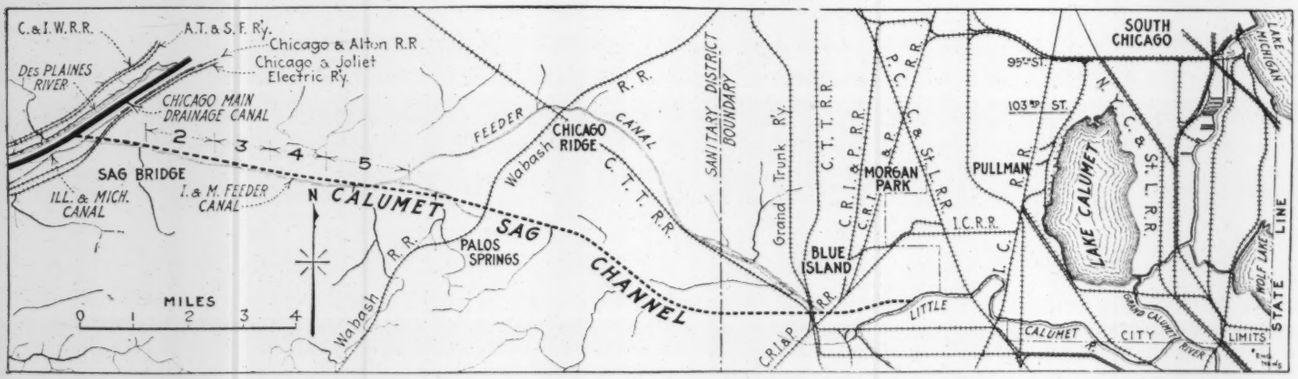


Fig. 1. Map of the Calumet-Sag Drainage Canal; Sanitary District of Chicago

Cross-Section

On account of the marked difference in the character of material encountered, two different types of channel sec-

*Division Engineer, Sanitary District of Chicago, American Trust Bldg., Chicago.

†The Calumet-Sag Canal and the sewage-disposal problem of the Calumet section of the Chicago Sanitary District have been dealt with in our issues of July 22, 1909; June 16, 1910; Feb. 22, 1911, and Nov. 3, 1911.—Editor.

tion are to be constructed, the "rock section" and the "earth section." These are shown in Fig. 2. Each is capable of carrying 2,000 cu.ft. of water per second, with a depth of 20 ft. and an available fall of about 3 ft. from Lake Michigan to the main drainage canal at Sag. & Michigan Canal, while that of the east half is carried east into the Little Calumet River. These ditches are connected with the channel at frequent intervals by cross-ditches, concrete outfalls being provided at their outlets.

At the present time four contract sections are under

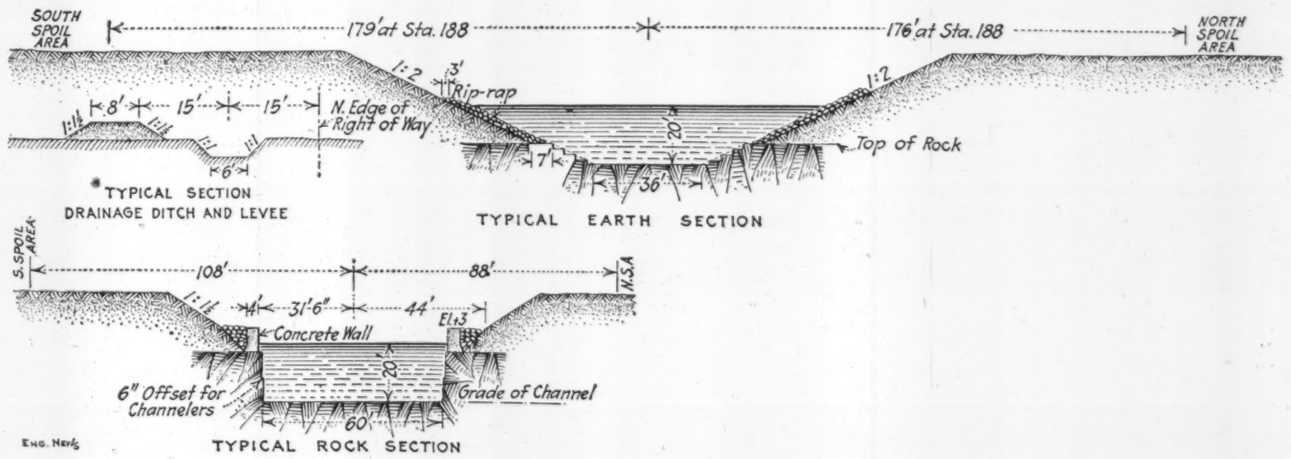


FIG. 2. TYPICAL CROSS-SECTIONS OF THE CALUMET-SAG CANAL

(In earth sections, where rock is above El.15, it will be excavated 2 ft. (measured horizontally) outside the theoretical prism, and this 2-ft. space will be filled with rip-rap.)

Where the rock cutting exceeds 15 ft. the "rock section" becomes the more economical. This section is 60 ft. wide on the bottom, with vertical channeled rock sides, and concrete walls on both sides of the channel extending 5 ft. above the proposed water surface. The wall, which is shown in section in Fig. 3, may be made with the rear face battered or stepped, at the option of the contractor. In either case, payment will be made for the actual amount of concrete measured in place. The expansion joints are 50 ft. apart, with a 4-in. weeper or drain through the bottom of the wall midway between the joints. The earth is sloped back from the wall to the ground surface and the space behind the wall is backfilled with rock. Where the rock cutting is less than 15 ft. the "earth section" is used. This section is 36 ft. wide on the bottom and about 190 ft. wide at the ground surface, with the side slopes in both rock and earth excavated to an inclination of 1 on 2.

Rip-rap, composed of broken stone excavated from the channel, is hand-placed on both slopes from the rock surface up to an elevation 3 ft. above the proposed water surface. On the "rock section," berms are provided from 30 to 50 ft. wide, while on the "earth section" the north berm is 50 ft. wide and the south berm from 90 to 100 ft. wide. The larger south berm is to permit a future enlargement of the channel without rehandling spoil. The material excavated is deposited on both sides of the channel. The spoil area extends from the berm to the right-of-way line, with the exception of a narrow strip about 40 ft. wide along both the north and south sides of the right of way, which is reserved for a collateral drainage ditch. The spoil areas on each side of the channel vary in width from 200 to 1200 ft., the wider areas being required through the swampy portion.

The drainage ditches along the edges of the right of way are designed primarily to intercept and carry off surface drainage during construction. The drainage from the west half of the work is carried west into the Illinois

construction: Sections Nos. 2, 3, 4 and 5, whose location is shown in Fig. 1.

CONSTRUCTION WORK ON SECTION NO. 2.

Section 2 is a "rock section" 6754 ft. long, and comprises the excavation of 221,000 cu.yd. of glacial drift and 351,000 cu.yd. of solid rock; the channeling of 313,000 sq.ft. of rock face, and the construction of 6400 cu.yd. of concrete retaining wall. The contractor is the Winston Bros. Co., of Minneapolis, Minn., and is doing this work at the following prices: glacial drift excavation, 22c. per cu.yd.; rock excavation, 65c. per cu.yd.; channeling, 20c. per sq.ft.; concrete retaining wall, $7 per cu.yd.

Work on this section was commenced April 2, 1912, the drainage ditch along the north edge of the right of

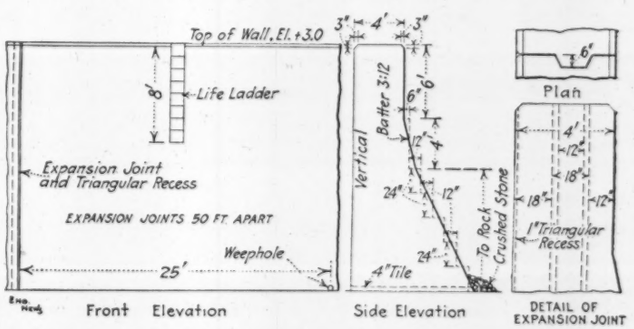


FIG. 3. CROSS-SECTION OF RETAINING WALLS ON THE ROCK SECTION OF THE CALUMET-SAG CANAL

(The battering or stepping of the rear face is optional with the contractor.)

way being the first work done. This ditch is shown in Fig. 4. Teams, scrapers, and a drag-line excavator were employed. The drainage ditch along the south edge of the right of way had already been excavated by the Sanitary District to afford an outlet for drainage from work already in progress farther east.

FIG. 4. DITCH FOR DRAINING THE SITE OF THE CALUMET-SAG CANAL: SECTION NO. 2
(The spoil bank at the right is that of the canal.)

The excavation of glacial drift in the channel proper is being done with a Bucyrus drag-line excavator, moving along the berms. The machine is equipped with an 85-ft. steel boom and with both Bucyrus and Page 2½-yd. buckets (Fig. 5). The cut averages about 8 ft. The black dirt is stored separately on the south berm, the intention being to later remove it for use in the Chicago parks, while the remainder of the glacial drift is being deposited on both sides of the channel in the spoil areas provided. This machine has averaged about 50,000 cu.yd. per month, working one daily shift of 10 hr. The average force employed was about 10 men.

After the rock surface was cleared, the work of cutting the vertical rock faces of the prism was commenced, two Ingersoll-Rand steam channelers being employed on each side of the channel. The average total height of the rock faces will be about 26 ft. and is divided into three lifts, the top lift being about 6 ft. and the other two lifts about 10 ft. each. The channeling of the top lift cost about 35c. per sq.ft., as against a contract price of 20c. This high cost was due to the nonuniformity and poor quality of the rock encountered, and the shallow depth of the cut, which required frequent moving of the channelers. The remainder of the faces being channeled in two lifts of 10 ft. each and through sounder rock, the machines are expected to work much more economically. Two additional channelers were later employed, as it was found that the four originally installed were of insufficient capacity to keep the channeling in advance of the drilling and blasting. Fig. 6 shows the channelers at work on each side, and also the pumping plant, beyond which is the dump track on the spoil bank.

Drilling is being accomplished by means of two Ingersoll-Rand steam drills, each having its own boiler and mounted on trucks as shown in Fig. 7. The blasted rock is loaded on 4-yd. dump cars by means of a 70-ton Bucyrus steam-shovel and hauled to the spoil area by small locomotives in 11-car trains. Present progress averages 800 cu.yd. of rock per day. Fig. 8 shows the rock after being blasted to a depth of 10 ft. The channelers, drills and pump may be seen in advance, and the dump track is in position on the rock surface. The total estimated value of this contract is $365,070, and the work is required to to be completed by Oct. 1, 1915.

CONSTRUCTION WORK ON SECTION NO. 3

Section 3 lies immediately east of Section 2, and is 5397 ft. long. It is a "rock section," except at the extreme east end, where the change in character of the material necessitates a change to the "earth section" before mentioned. This section comprises the excavation of 335,000 cu.yd. of glacial drift and 220,000 cu.yd. of solid rock; the channeling of 182,000 sq.ft. of rock face, the construction of 3400 cu.yd of concrete retaining wall, and the placing of 5000 sq.yd. of rip-rap slopes. The contractor, S. R. H. Robinson & Son Contracting Co., of St. Louis, Mo., is doing this work for the following prices:

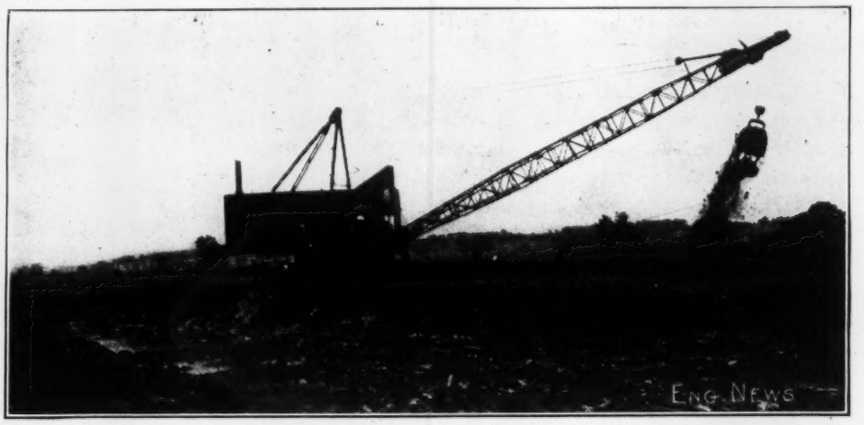


FIG. 5. DRAG-LINE SCRAPER-BUCKET EXCAVATOR ON THE CALUMET-SAG CANAL

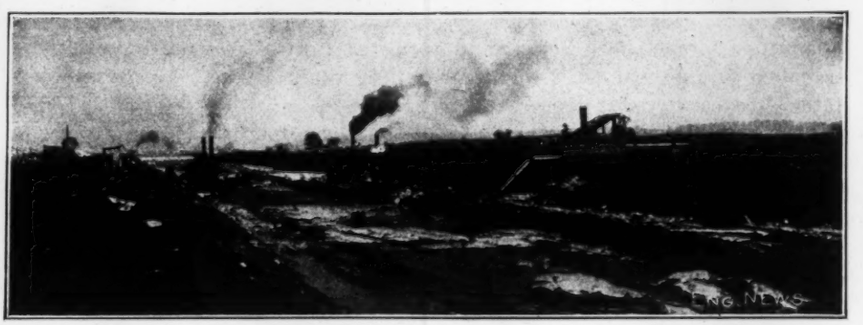


FIG. 6. CHANNELING THE SIDES OF THE ROCK EXCAVATION FOR THE CALUMET-SAG CANAL: SECTION NO. 2
(There are two channelers on each side. On the right is a drainage pump, with the spoil bank, and dump track behind it.)

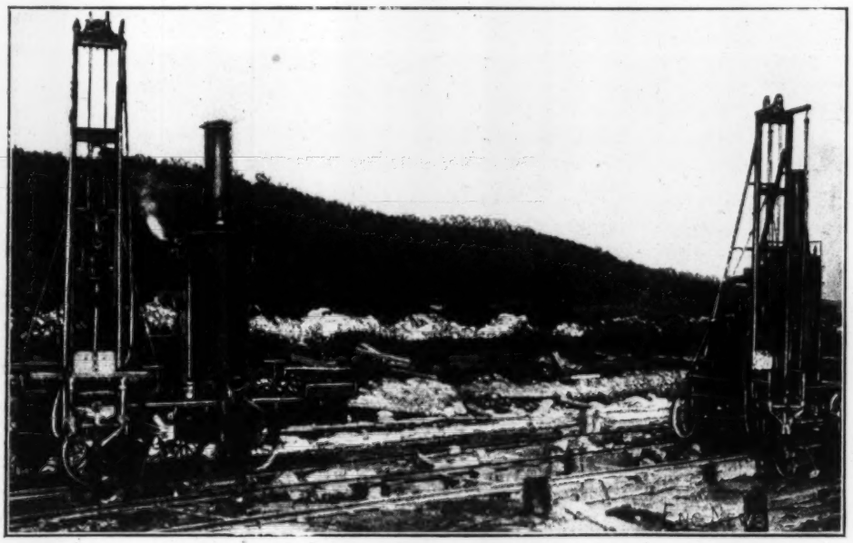


FIG. 7. STEAM DRILLS ON THE CALUMET-SAG EXCAVATION

glacial drift excavation, 29c. per cu.yd.; rock excavation, 69c. per cu.yd.; channeling, 25c. per sq.ft.; concrete retaining wall, $4.95 per cu.yd.; rip-rap slope, $1 per sq.yd.

Work under this contract was commenced March 22, 1912. After erecting a labor camp and performing other preliminary work, excavation was started on the north drainage ditch, this work being performed by hand. The south drainage ditch had already been constructed by the Sanitary District, a 40-ft. ditch 5 ft. deep, having been excavated by means of a floating dredge following the course of an old feeder channel of the Illinois & Michigan Canal. A Lidgerwood steam drag-line excavator with a 100-ft. boom and 2½-yd. Page bucket is being employed to excavate the glacial drift from the channel proper, the machine moving along one berm to the end of the section and then back along the other berm. Thus the material is deposited on the spoil banks on both sides of the channel.

The excavation of the glacial drift immediately overlying the rock to a depth of 5 or 6 ft. is attended with the greatest difficulty. The material is composed of a cemented rock and gravel. It has been found necessary to form powder holes by driving bull points into this layer and then blasting, after which the material is removed by the drag-line excavator. No work on rock has been done as yet on this section. The total estimated value of this contract is $365,855, and the work is required to be completed by Oct. 1, 1915.

CONSTRUCTION WORK ON SECTION NO. 4

Section 4 lies immediately east of Section 3. It is an "earth section" 5377 ft. long, and comprises the excavation of 780,000 cu.yd. of glacial drift and 121,000 cu.yd. of rock, and the construction of 37,000 sq.yd. of rip-rap slope. The contractor, Thomas J. Forschner, Lemont, Ill., is doing this work at the following prices: glacial drift excavation, 25c. per cu.yd.; rock excavation, 77c.; rip-rap slope, 50c. per sq.yd. Work under this contract was commenced in September, 1911, when hand excavation of the north drainage ditch was started. The south drainage ditch (40 ft. wide) was excavated by means of a floating dredge. The total estimated value of this section is $314,506, and the work is required to be completed by Aug. 1, 1915.

The excavation of the channel proper was commenced early last year, a Marion self-propelling steam drag-line excavator with 100-ft. steel boom being employed. This machine is equipped with a 3½-yd. and a 6-yd. Marion bucket, the larger bucket being used for the excavation of the peat and other light material found near the surface. An interesting feature of this machine is the placing of hydraulic jacks under each corner. These jacks automatically keep the swinging parts of the machine level through all positions, and have been found to operate very successfully. Their value lies in the saving of time necessary to keep track level and the reduction in the wear and tear of the machine. The output of the excavator for the last five months has averaged 60,000 cu.yd. per month, working two 10-hr. shifts per day and employing an average force of about 12 men per shift. Up to the present time no work on rock excavation or rip-rap slopes has been done on Section 4.

CONSTRUCTION WORK ON SECTION NO. 5

Section 5 lies immediately east of Section 4. It is an "earth section" 8127 ft. long, and comprises the excavation of 1,070,000 cu.yd. of glacial drift and 141,000 cu.yd. of rock; the construction of 69,000 sq.yd. of rip-rap slope, 4800 lin.ft. of roadway, 1000 cu.yd. of miscellaneous concrete work, 900 cu.ft. of concrete cylinders, and the erection of two fixed highway bridges. The contractor, Green & Sons Co., of Chicago, are doing this work at the following prices: glacial drift excavation, 24c. per cu.yd.; rock excavation, 70c.; rip-rap slopes, $1 per sq.yd.; roadway construction, $1 per lin.ft.; No. 1 concrete, $10, and No. 2 concrete, $7 per cu.yd.; concrete cylinders, 60c. per cu.ft.; and $3000 each for the two highway bridges.

Work under this contract was commenced about July

FIG. 8. ROCK AFTER BLASTING (10-FT. DRILL HOLES); CALUMET-SAG CANAL

1, but up to November operations had been confined to preliminary work such as drainage ditches, stripping and storing of black dirt, camp construction, etc. Two Lidgerwood drag-line excavators with 100-ft. steel booms and 2½-yd. Page buckets are now being erected. These machines will be electrically operated, a transmission line 15 miles long having been built to furnish power to various points along the channel. A feature of this section is the use of Cippoletti or notch weirs for the concrete outfall and spillway at Milk Creek, a stream entering from the south, with a maximum flow of about 350 cu.ft. per sec. By this design it is the intention to obviate difficulties to navigation caused by cross-currents in the channel, and also to prevent excessive velocities and scouring in the creek. The total estimated value of this contract is $444,990 and work is required to be completed by Oct. 1, 1915.

Railway Crossing of Canal

The Wabash R. R. is engaged in straightening its line across the swamps between the towns of Worth and Palos. This work involves the relocating of the Wabash R. R. crossing of the Calumet-Sag Channel to a point about 1600 ft. west of the present crossing. The bridge and approach embankments are to be built by the railway company, but the Sanitary District has agreed to repay it the expense incurred in building the bridge. Work on the fill is now in progress, and the bridge will probably be built before that section of the canal is let, thus requiring the construction of the channel under the completed bridge. This, and all bridges over the channel, will have a clearance of 16.5 ft. and a clear middle span of 60 ft. The contractor doing this work for the Wabash R.R. is John Marsch, of Chicago.

Future Work

Section 1, the most westerly section which will connect the Calumet-Sag Channel with the Main Drainage Canal, will be a "rock section," and this will probably be the last work let. The sections through the city of Blue Island will also be "rock sections" having a concrete wall on both sides. This portion of the canal presents many difficulties in the way of crossing railways, streets and sewers, and the care which must be observed in blasting. All excavated material will have to be transported and leveled off in the spoil areas provided. The channel lies practically through the business section of the town.

In addition to the work now under contract, the Sanitary District is engaged in excavating a drainage ditch, known as the North Diversion Ditch. This work is preliminary to letting contracts for the construction of the channel through the middle portion, the purpose of this ditch being to provide an outlet for drainage from the swamps. This work is being performed with a floating Marion dredge equipped with a 40-ft. boom and a 1¼-yd. dipper. Cemented-gravel, which requires shooting, is being encountered, making progress slow.

The work of preparing plans and specifications for the construction of additional sections is well under way, and contracts will be let as rapidly as conditions will permit. The great difficulty lies in acquiring the right of way, the Sanitary District policy being to purchase this by mutual agreement wherever possible. This method has been found to be more satisfactory eventually than that of condemnation.

Camps and Labor

An item of interest to contractors is the difficulty that has been encountered in engaging and holding common labor. This scarcity has necessitated the payment of higher wages and the maintenance and operation of camps and commissaries at a loss. The labor is mostly Austrian and Italian. Camps are equipped with shower baths and all possible conveniences. Water for camps and for the work is supplied by reservoirs constructed on the south bluffs, these reservoirs being filled by pumping from wells and by rain water. By this means a gravity flow under a head of from 50 to 60 ft. is available at all times. Coal and other material is hauled by wagon from Worth, Ill., on the Wabash R.R., or Lambert, Ill., on the Chicago & Alton R.R., over roads which are fair in good weather and bad in wet weather. The longest haul is about three miles. The canal and right of way are patrolled by Sanitary District police, and rules requiring order and a sanitary condition of the camps, etc., are rigidly enforced.

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The Urban Population on American Rivers used for public water-supplies after filtration, was tabulated by Allen Hazen, and a few comparative figures for European cities given in a report on water purification submitted to the city of Ottawa, Ont., in November, 1912, as follows:

Place	River	Drainage area above city sq.miles	Urban population 1910 Census. Total	per square mile
Albany	Hudson	8,240	468,117	57
Atlanta	Chattahochee	1,560	5,925	4
Binghamton	Susquehanna	2,279	18,926	8
Chattanooga	Tennessee	21,418	113,351	5
Chester	Delaware	10,450	2,210,018	211
Cincinnati	Ohio	72,400	2,116,912	29
Elmira	Chemung	2,107	31,231	15
Grand Rapids	Grand	4,800	67,692	14
Harrisburg	Susquehanna	24,030	626,497	26
Indianapolis	White	1,820	67,678	37
Knoxville	Tennessee	9,530	77,005	8
Lawrence	Merrimac	4,634	364,858	79
Louisville	Ohio	91,000	2,989,458	33
Minneapolis	Mississippi	19,585	25,204	1
Paterson	Passaic	773	24,905	32
Philadelphia	Delaware	8,186	325,147	40
Philadelphia	Schuylkill	1,915	229,176	120
Pittsburgh	Alleghany	11,400	259,966	23
Pittsburgh	Monongahela	7,600	235,072	31
Poughkeepsie	Hudson	11,600	637,015	55
Toledo	Maumee	6,723	148,380	22
Washington	Potomac	11,476	100,950	9
Youngstown	Mahoning	967	34,525	36
Ottawa	Ottawa	34,623	20,839	0.6

In Europe, where the population is much more dense than in the United States and Canada, water has been taken from the rivers for purification, and the amount of sewage which rivers receive, has often been very much greater than it has been in most of the American rivers. For example:

City	River	Drainage area sq.miles	Population in large cities* Total	per sq.mile
Bremen	Weser	15,100	679,196	45
Rotterdam	Rhine	75,000	5,892,705	79
Altona	Elbe	52,000	6,556,500	128

* These figures are not comparable with the American ones because they only include cities of over 100,000 inhabitants each. The data are not readily available for smaller cities. If these could be added the totals would be greatly increased.

In England, London takes most of its water from two rivers, the Thames and the Lea. The Thames above the intakes has a catchment area of 3548 sq.miles, with a population in 1891 of 1,055,415 or nearly 300 per sq.mile. There were seven cities with more than 10,000 inhabitants each and a combined population of 183,328 or 52 per sq.mile. The Lea, with a catchment area of 460 sq.miles, had a population at the same date of 189,287 or 412 per sq.mile, with one city with 30,005 inhabitants or 65 per sq. mile.

These figures are important in showing the successful purification and use of water from rivers with very much greater urban population and pollution, in some cases more than a hundred times as great as on the Ottawa River. [The total population on the Ottawa drainage area is only three per square mile—Ed.].

Drawbridges over Rivers Having Limited Navigation*

By C. E. SMITH†

The Missouri Pacific Ry. crosses a number of navigable rivers and maintains 30 movable bridges. The spans vary in length from a 36-ft. deck-plate girder bascule bridge to a swing span 440 ft. in length. The amount of navigation varies with the locality and with the season of the year. Some of the bridges have never been opened for boats since their construction; some are opened only a few times each year, while others are opened once (and sometimes oftener) each day during favorable stages of water and not at all for months during low-water periods.

On most of these rivers the navigation is notable by its absence, and in no case is there sufficient to afford any comparison between the tonnage passing under a bridge by boat and that passing over the bridge by rail. The latter is always many times, and frequently thousands of times, as great as the former. Notwithstanding the preponderance of rail traffic, however, the boat traffic gets the preference, and where there is necessity of delaying either a train or a boat the federal government has ruled that the boat must be given the preference, even though that might mean the stopping of the train.

A few months ago a boat approached one of the bridges a few minutes before the schedule time of a fast mail-train, which had been reported to the drawtender as being on time. The drawtender realized that he might not be able to open the bridge, pass the boat and close the bridge without delaying the mail train, so he waited until after the train had passed before opening the draw. The boat suffered a total delay of about 10 min. Complaint was lodged with the federal attorney, who took the matter up with the legal department of the railway company. It was ruled that the only condition under which it would be permissible to hold a boat to permit a train to cross would arise when the train was so close to the bridge that it could not be stopped before crossing.

The most important of the federal laws with reference to movable bridges is the Act of March 23, 1906, sometimes referred to as the General Bridge Act. In addition to the general laws governing movable bridges over navigable rivers, the War Department issues rules and regulations to govern the openings of bridges, these varying as may be necessary to meet local conditions.

What Is a Navigable River?

The question naturally suggests itself: "What is a navigable river"? The federal laws do not afford an answer and there is no competent general ruling in existence, nor does it seem possible that there can be given a satisfactory definition. Particular streams or parts of streams have been and may be declared navigable by Acts of Congress, by rulings of the War Department or by courts of competent jurisdiction. A definition given by a U. S. Engineer officer is as follows:

"A navigable stream is one which in a state of nature carries or is capable of carrying commerce in the manner in which commerce is usually carried."

The writer has concluded that the following general definition is as good as any; but in applying it to any particular case the rule of reason must be observed:

"A navigable river is one that has been declared navigable by competent authority, or that is in fact navigable at any time by any boat or raft."

All rivers that are designated as navigable are not navigable in fact, nor does the War Department require the construction of movable bridges over all so called navigable rivers. A notable example of this is the Kaw River, which joins the Missouri River at Kansas City, Kan. The Kaw has been declared a navigable river, the Government has established harbor lines for quite a distance above its mouth and has ordered the reconstruction of a large number of bridges to provide increased height, width and depth of foundations, the latter to do away with the necessity for protecting former piers with riprap.

In a distance of five miles above its mouth the Kaw is crossed by 15 bridges none of which have movable spans. With a few exceptions, the clearance of the steelwork will be only a few feet above high-water level, effectually preventing navigation at high water, which would otherwise be prevented by the swift current. At extreme low water the clearance under the bridges is about 30 ft. and the depth of water hardly sufficient to float a small barge. An occasional sand barge uses the river at occasional favorable stages and that constitutes the navigation. The jurisdiction of the War Department over the river is absolute, however, and the reconstruction of bridges now under way to comply with Government requirements will cost several millions of dollars.

The example is cited here simply to call attention to the reasonableness of the U. S. Engineers in not demanding movable bridges to accommodate a small amount of navigation. In fact the result of the writer's negotiations indicates the uniform reasonableness of these engineers in their interpretation of the laws and rules relating to navigable rivers.

Arrangements for Opening Drawbridges

Although theoretically it is the duty of the railway to maintain watchmen and turning machinery at each of its movable bridges and to be always ready to open a bridge at a moment's notice, it is practically unnecessary to bear such expense continuously at bridges that are seldom or never opened. At such points it is customary to lay the rails continuous over the bridge, to set the end wedges (in a swing bridge) so that the draw will not tip under traffic, and to dispense with watchmen. When such bridges must be opened it is customary for the boat owner or master to notify the section gang or nearest local agent, who arrange to open the bridge or to secure the necessary help. The relations between the railway company and the boatmen at such places have invariably been harmonious, as such relations usually promote the interests of both parties.

Occasionally, however, a boat owner approaches a drawbridge over such a steam with the apparent expectation of immediate attention, though his may be the first boat at that point in years and his arrival unexpected. His presence is usually discovered by the section gang or by a crew on a passing train, in which latter case the sectionmen are sent to investigate. The opening of the bridge soon follows. In such cases there is usually a claim for damages for the delay to the boat, and the railway company settles outside of court if the boat owner can be prevailed upon to see his loss (if any) in a reasonable light. An unreasonably large claim for one day's delay at a bridge that had not been opened previously for six years is now being adjusted.

Another fruitful source of complaint is the presence of stubs of old falsework piling in the channel. These are sometimes left in by the contractor cutting the piles off at extreme low water, assuming that boats cannot use the river until the water is deep enough over the pile stubs to float the boats, or by breaking the piles off, presumably at the bottom of the river but frequently higher; or they are the remaining stubs of piles that may have been swept away by flood and driftwood, or portions of some former bridge. It is practically certain that sooner or later a boat will hit them and they will result in delay or damage or both, with resulting claims. It is the practice of the writer in all cases to insist on the pulling of all false-work piles and former pile piers that stand in navigable channels, and this requirement is clearly set forth in the specifications and carefully watched.

It occasionally happens that navigation develops in a stream over which a bridge with fixed spans has been maintained for many years. In many cases such bridges must be reconstructed as movable bridges, but in others the necessity for permitting boats to pass occurs so seldom that when the design of the bridge permits, the most economical solution is the occasional temporary raising or removal of a span by means of a derrick car. There are many bridges that have been opened in this manner for years.

At bridges that are seldom opened, but where watchmen are maintained, it is difficult to maintain discipline on account of the monotony. The watchmen frequently leave the bridge between trains for shooting or fishing trips, with consequent delays to boats and subsequent complaints.

Drawbridges over Shifting Channels

It is, under the law, clearly the duty of the railway company to maintain channels under movable spans or to maintain movable spans over channels. It frequently happens, after a movable bridge has been constructed over the then channel, especially in a stream subject to quick rise, swift flow and shifting of sandy bottom, that the former channel under the movable span will fill up and a new channel be formed under one of the fixed approach spans. When this takes place it becomes a very nice problem to determine what course to pursue.

In the construction of the Illinois Central R.R. bridge over

*Abstract of a paper on "Bridges over Navigable Rivers," in Bulletin No. 150 (October, 1912) of the American Railway Engineering Association (Chicago). Decriptions of some methods of providing temporarily for navigation at drawbridges under construction, which are given in this paper, appear on pp. 153-5, of this issue.

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the Missouri River near Omaha, Neb., the channel moved out from under the original draw span while it was under construction. The company immediately arranged for the construction of a second draw span, duplicate of the first, to span the remainder of the river, so there are now four draw openings. For a somewhat similar reason the bridge of the St. Louis Southwestern Ry. over the Arkansas River, near Pine Bluff, Ark., has two draw spans.*

The problem of maintaining a movable span over the channel has been simplified by the recent development of the vertical-lift bridge. With this type of bridge it is practicable to cross a river with a number of simple spans of equal length on ordinary piers. The towers, counterweights and lifting mechanism are first applied to the span over the channel. At any later date, the lifting apparatus may be moved to lift any other span under which the channel may be, and the cost of the change will be only nominal as compared to the cost of changing any other type of movable bridge for a similar purpose. A bridge designed with this idea has recently been completed across the Arkansas River between Fort Smith and Van Buren, Ark. There are nine spans 196 ft. in length.

Location of Drawbridges

When a proposed bridge is to replace a former bridge which has been easily passed by boats and in regard to which there have been no complaints from the river interests, the approval of the U. S. Engineer Officer is usually merely a matter of form. Where boats have had difficulty in passing through the opening, or where there have been complaints for other reasons, or in the case of a bridge in a new location, the Engineer Officer either corresponds with the interested parties or holds a public hearing to determine what provision must be made for navigation. The width of opening and location of channel are matters, the determination of which frequently takes many conferences and much time.

From the standpoint both of the railway company and of the War Department it is most desirable that a movable bridge be located in the longest possible straight reach of the river, but conditions frequently impel the railway to choose a less desirable location. Where a bridge is located near or at a bend in the river, the boat owners and the War Department usually demand a larger opening than would be demanded in a straight reach. Two drawbridges were constructed over the Black River in Arkansas in 1911. The bridge near the mouth has a 267-ft. draw-span, providing openings 118 ft. wide in the clear, which is ample on account of the straight river; the other bridge, about 100 miles from the mouth, has a 440-ft. draw-span providing openings about 200 ft. wide in the clear, which is necessary on account of being located in a sharp bend.

Maintaining Navigation during Construction

The rights of navigation must be respected during the construction or reconstruction of a bridge and it is the duty of the railway to maintain navigation or to pay damages that are incurred by private parties if the channel be obstructed. Each case must be handled on its merits, controlled by local conditions such as actual and relative amounts of rail and boat traffic. In the case of very heavy traffic lines it is preferable (where practicable) to change alignment when such bridges are reconstructed, in order to avoid interference with either class of traffic. In congested districts this is frequently impossible and it becomes necessary to reconstruct in the former location under traffic. On light traffic lines interference with trains can be avoided without much increase in cost, so that the extra cost of changing the location is seldom warranted and it is most economical to reconstruct in the former location under traffic.

The writer has heard of instances of navigable rivers being declared closed for specified periods by the Chief of Engineers or Secretary of War or by Congress, but it is the invariable practice at the present time to refuse permission to close the channel even for a short period. It might be possible to secure the passage of an Act of Congress closing a river to navigation during a specified period for the reconstruction of a bridge, but it would probably be against the recommendation of the War Department and consequently would require more powerful political influence than most railways can command or would care to use for such a purpose if available.

It becomes practically necessary to work out a method of reconstruction that will not obstruct navigation or to pay the damages that are incurred by private interests. The U. S. Engineer Officer will usually make arrangements, if possible, to keep government boats away from the bridge, if request be made, for a reasonable period, but this is not always possible. It has been the uniform experience of the writer that the Engineer Officers are ready to make reasonable sacrifices where practicable, to avoid interference with the bridge construction.

Contractor's Responsibility in Keeping Navigation Open

It was the practice of many railways in the past (and the practice still obtains on some roads) to compel the contractor to work out a method of taking care of navigation and to make him responsible for any damages arising out of delays or injuries to boats during construction. This practice was objectionable for several reasons. Bidders would not familiarize themselves sufficiently with local conditions to be able to make a close estimate of the probable cost to which they would be put in caring for navigation; consequently a sum based on a guess would be added to the bid. In case the sum was too large, the railway would pay for more than it was getting; if too small, the contractor would soon find it out and would make every effort to keep within his estimate, with consequent delays to boats and dissatisfaction among their owners.

It is well to realize that the railway company must pay for the delays to navigation or for the means to avoid delays, and that it is better to pay the actual amount in either case than to gamble on it by getting an estimate. It is not difficult to write the specifications covering any specific case in such a manner that the contractor will not be subjected to a hardship or forced to take an unreasonable profit.

In the Southwest it is practically impossible to predict the amount of navigation that will be carried on during the reconstruction of a bridge. Of course every effort is made to carry out the work during expected periods of low water, but after five years' experience with rivers in the Southwest it appears to the writer that there is no certain period of low water. The rivers are almost certain to be high from November to July and are frequently high from July to November; in fact, during some years there are no well-defined low-water periods. If the river reaches a sufficiently low stage, however, navigation will cease entirely. On the other hand, the uncertainty of the low-water period and the fact that frequently the stage of a river throughout an entire year is sufficient for navigation, make it necessary to provide for navigation during construction.

It is sometimes possible, where a portion of a river is used by only a few boats, to make amicable arrangements with the owners, possibly by the payment of relatively small sums, so that the company will be safe in closing the channel. Such a course, however, is invariably followed by an immediate increase in the number and importance of the boats using the river. The writer has been forced to the conclusion that there is no method of stimulating navigation over any portion of a river so effective as the construction or reconstruction of a bridge.

Practice on the Missouri Pacific Ry.

There are many ways of taking care of navigation during construction, each case presenting an entirely different problem, the solution of which depends on local conditions. On the Missouri Pacific Ry. it is the practice to let separate contracts for substructure, fabrication and erection of each bridge.

It is the invariable practice of the writer to design the substructure of the new bridge in such a manner that, whether it be a new location or renewal, the foundation can be put in and completed without stopping navigation. Provision is then made in the specifications that the contractor's work must be carried on in such a way as not to interfere with boats and he is held to strict compliance with that provision. Considerable contraction of the channel is usually possible during construction for the reason that the boats are much narrower than the channel, the greater permanent width being required to provide for free passage under all conditions.

The method of erection that will be followed is worked out and described in detail in the specifications. Erection is usually let on a tonnage basis, the price including putting in and taking out the falsework. If any special arrangement of falsework is necessary, such as the installation of a girder span on pile piers, the bidders are requested to name a price for making the special arrangement. Bidders are also requested to name a unit price for each time the bridge must be opened during erection to permit the passage of a boat. The specifications also provide that during erection the contractor's work must be carried on in such a manner as not to interfere with boats. Since the above method of handling has been adopted very little trouble has been experienced in taking care of navigation.

*The Arkansas River bridge near Pine Bluff, Ark., has two swing spans, providing four channels 222 ft. c. to c. of piers; these swing spans are separated by two fixed spans 253 ft. 7½ in. c. to c. of piers.

Providing for Navigation During the Erection of Drawbridges

In a paper on "Bridges Over Navigable Rivers,"* by C. E. Smith, Bridge Engineer of the Missouri Pacific Ry., attention is called to the necessity of providing a temporary opening during the construction of a drawbridge, even when the navigation is extremely limited. In describing the construction of a number of river bridges on the Missouri Pacific Ry., particulars are given of the means provided for taking care of occasional vessels and this information we have abstracted below.

Tensas River Bridge

The old bridge over the Tensas River, near Clayton, La., consisted of a 150-ft. Howe truss draw-span with pile trestle approaches. The new bridge consists of a 150-ft. deck plate-girder disk-bearing draw-span and four 75-ft. deck girder approach spans, on concrete piers and abutments.

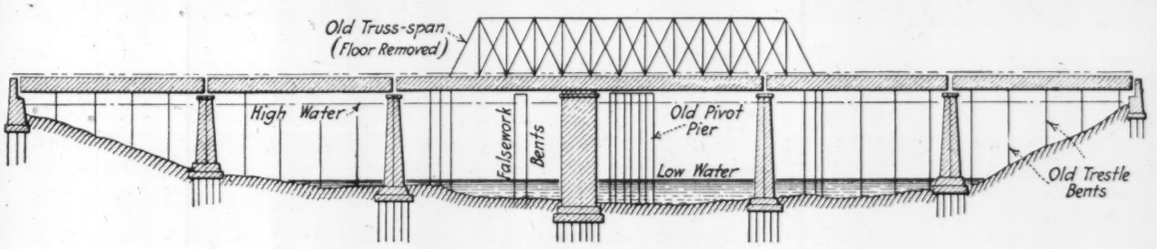

Fig. 1. Reconstruction of Drawbridge over the Tensas River (Louisiana); Missouri Pacific Ry.

(The new piers, girder fixed spans and girder draw-span are shown in hatched lines. The trusses of the old draw-span are in place, but with the floor removed to admit the new span.)

The four approach spans were placed by gallows frames resting on the ends of the piers. The girders (on cars) were run out under the frames, raised off the cars and the cars pulled away. The rails, ties and trestle in the way of the girders were then removed, the girders lowered to place and track connected up.

The draw-span girders were each shipped in three pieces, to be spliced in the field. Each section was placed in a manner similar to that used for the approach spans, the old pivot pier being used for falsework under the north splice, and falsework being placed under the south splice. During the placing of the sections of the draw-span girders the floor system of the truss-span was cut away and the trusses left in place. After the girders were in place the trusses were thrown into the river, floated out to the bank and dismantled there. The arrangement is shown in Fig. 1.

For the greater part of the time during the erection of the new draw span the water in the river was so low that no large boats could navigate and such small boats as could navigate could pass under the bridge. For that reason no special effort was made to effect a quick change from the old to the new span. The first turning of the new span was accomplished in about two weeks after the last turning of the old span. Near the completion of the erection the water rose to a point that permitted a boat to reach the bridge before the new draw span was ready to turn. The slight delay to the boat resulted in a claim for damages of $75, which was easily settled.

*This is published in Bulletin No. 150 (October, 1912) of the American Railway Engineering Association (Chicago), and an abstract of it is given on pp. 151-2 of this issue.

Black River Bridge

The old bridge over the Black River, near Paroquet, Ala., consisted of a combination fixed span 103 ft. 6 in. long and a Phœnix draw-span 206 ft. 6 in. long, on pile piers with trestle approaches. This was replaced (on the same center line) by a 267-ft. draw-span with concrete piers, and a 60-ft. deck plate-girder span with trestle approaches. Fig. 2 shows the method of erection and the temporary lift span.

The specifications for erection provided that the expense of caring for navigation would be borne by the railway. It was calculated that the falsework could be placed, the old span taken down and the new span erected and adjusted ready for turning in about six weeks. A canvass among the owners of boats that passed through the bridge indicated that their claims for damages for that length of time would certainly amount to from $15,000 to $20,000, and would probably greatly exceed that sum, as other boats would be drawn by the opportunity.

The large claims that could be foreseen caused the decision to install between the old and new east piers a second-hand deck plate-girder lift-span with timber towers and old rail counterweights. This was installed ready for operation before the old draw was placed out of service. The completion of the falsework, taking down the old span, and erecting the new draw span, including riveting and adjustment of machinery, out to the temporary lift bridge were carried out at leisure without any interference with boats.

At an opportune time, the lift-span was taken down and the new draw-span extended to the shore pier. During the latter operation the river was blocked a few days, which constituted the only time the river was blocked during the reconstruction of the bridge. In spite of all these precautions, however, claim for damage due to delay was filed by the owner of a boat which arrived at the bridge during the final extension of the draw-span.

White River Bridge

The old bridge over the White River, near Augusta, Ark., consisted of a 162-ft. pin-connected through-truss span, a 267-ft. rim-bearing draw-span of the same type, and two 65-ft. deck-girder approach spans. The new bridge has riveted truss spans of the same lengths as above, and two 60-ft. girder spans, the shortening of the girder spans being due to the enlargement of the piers. Fig. 3 shows the old draw-span with three panels removed to admit a temporary girder span, which could be removed when necessary by a derrick-car on the track laid on the new fixed span.

The experience in attempting to adjust claims from

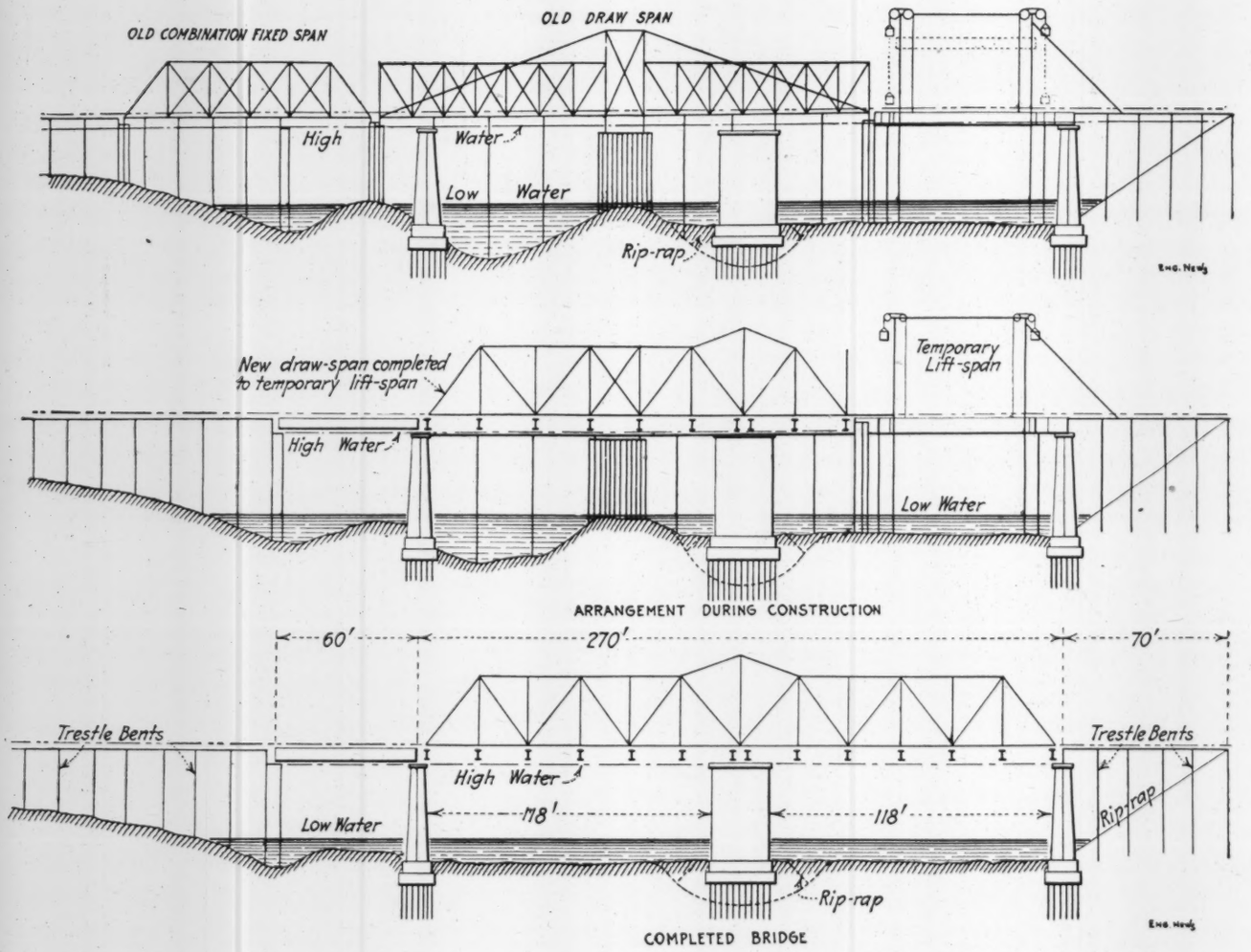

FIG. 2. RECONSTRUCTION OF DRAWBRIDGE OVER THE BLACK RIVER (ARKANSAS); MISSOURI PACIFIC RY.
(The old draw-span was shortened at one end to admit a vertical-lift girder span for a temporary opening.)

boat owners for the closing of the Black River (as described above) indicated that it would be best to make provision for navigation continuously during erection. The contractor was awarded a unit price per ton for the erection of the steel, a lump sum for installing a temporary deck-girder lift-span, and a fixed price for each time he had to open the bridge.

Towers and counterweights were not installed, but arrangements were made to lift the entire span out by the erector's derrick-car, which would move back with the span. Although no trouble had been experienced at Black River, it was seen that on account of the limited amount of lift that could practically be provided at reasonable expense on temporary supports, the arrival of a large boat at extreme high-water might find the lift span in its highest position too low, and it was to avoid such a contingency that the span was handled with a derrick-car at White River.

An opening 50 ft. wide was left in the east draw channel, just west of the rest pier, and a heavy pile bent was driven for the support of the temporary girders to be used for spanning that opening. Heavy pile bents were also constructed on each side of the pivot pier for the support of a deck-girder span over that pier to facilitate the reconstruction of the coping course.

When everything was in readiness, a quick change was made by removing two panels of the old draw span at the east end, and installing the temporary girder span over the channel. This change consumed about two days and no boats were delayed. The dismantling of the old span, reconstruction of the pivot pier and erection of the new span out to the temporary channel was carried out carefully with the realization that unusual speed was not necessary.

The draw was erected and riveted with the exception of the two east panels, after which another quick move

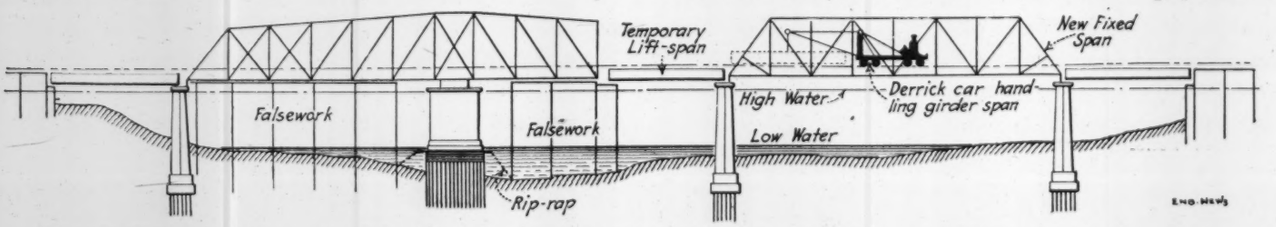

FIG. 3. RECONSTRUCTION OF DRAWBRIDGE OVER THE WHITE RIVER (ARKANSAS); MISSOURI PACIFIC RY.
(The old draw-span was shortened at one end for a temporary opening with a girder span, which could be lifted out by a derrick car and run back into the adjacent fixed truss span.)

was made in the removal of the temporary plate-girder span and completion of the erection of the draw span, which was ready for turning a few days after the deck-girder span was removed.

The installation of the temporary deck plate-girder span cost about $400. Each opening of this span during erection cost the railway company $10. For a period of about five years this bridge had been opened from five to ten times per month. During the erection of the new draw it was necessary to open the bridge nearly every day, a remarkable, but easily explained, increase in traffic.

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The Status of the Engineering Profession

SYNOPSIS—The following papers were read at the meeting of the American Institute of Consulting Engineers, New York City, Dec. 18, 1912.

❖

By L. B. Stillwell*

The history of those practical arts with which the engineer is concerned generally embraces, first, discovery, then invention, then commercial application. As an engineering art grows older, three tendencies which affect the work and relations of the engineer become manifest:

First—In certain large undertakings, such, for example, as railroad building and operation, great corporations are formed, and these soon employ engineering staffs.

Second—The art tends toward standardization. What at first was known only to a few becomes more or less common knowledge, and the need of specialists of the highest class is less obvious and less acutely felt, although perhaps not less real.

Third—The variety of engineering specialities associated in the construction problems presented by large and complex undertakings compels the coöperation of groups of specialists, and this situation leads to the formation of engineering corporations and partnerships, which, in turn, is frequently the first step toward a combination of the functions of the engineer, the contractor and the financier.

Obviously each of these three tendencies operates to limit the activities of the consulting engineer and to diminish his numbers, by substituting, as in railroad work, permanently retained engineering staffs; by diminishing his apparent usefulness because of the standardization of engineering practice, and by tempting him, first, to association in order to deal most effectively with complex problems, and then into the fields of contracting and financing in order to insure continuous occupation and increased remuneration for himself and his associates.

The characteristic American disregard for precedent; the equally characteristic American lack of respect for authority and special knowledge, and, I think it would not be unjust to say, the narrow and short-sighted view of directors and executive officers of some of our great corporations, have largely prevented the general adoption in this country of the practice of retaining consulting engineers after the period of active construction has passed. Time does not permit me to discuss the question whether the British practice of retaining consulting engineers to advise the management of a going concern, such as a railroad in full operation, is or is not, on the whole, wiser than the general practice in this country of getting rid of consulting advisers at the earliest possible date as construction approaches completion and thereafter placing full and undivided responsibility upon the operating staff. In this connection I may point out that, while the standardization of an art tends to make less obvious the value of the advisory service of the specialist, the increasing difficulty of effecting further improvement and economy as perfection is approached, argues on the other hand with increasing weight in favor of supplementing the efforts of the operating staff by the frequent criticism and suggestion of the most competent specialists.

To the three tendencies affecting the work and relations of the consulting engineer as a given art develops through discovery and invention to the stage of commercial application, frankness demands that we add a fourth, namely, the cumulative effect upon the opinions and the practice of executive officers and directors of those mistakes and misunderstandings which are practically inevitable in the progress of complex constructive undertakings carried through to completion, in many cases, by groups of men who perhaps are brought together in close working relations for the first time.

Too many real and serious mistakes are made by the incompetent or reckless engineer. In a much greater number of instances, mistakes between the banker, the executive and the engineer are responsible for disappointment and sometimes failure. In my opinion, there are perhaps no more important objects to be sought by this Institute than the elimination of the incompetent or reckless engineer and the prevention of those misunderstandings for which the engineer is sometimes in whole or in part responsible, but which more frequently is due to a lack of coördination of the activities of the banker, promoter and engineer, for which the engineer is not primarily responsible.

There are two specific phases of this very important subject, which I especially hope to hear discussed:

(1) What should be the attitude of this Institute as regards the competition from manufacturers and contractors which the consulting engineer encounters in the practice of his profession? Is the consulting engineer in what I may call an adult art a middleman who should be eliminated?

I ask this question in all seriousness. I have given the matter much thought and study and am not so sure but that, as in many cases of important projects in the past and today, the answer should be in the affirmative.

(2) The problem of eliminating, or at least restricting, the incompetent or careless engineer who brings discredit upon the profession. In this connection I think we should consider the question whether any practicable plan can be devised which, in apparently flagrant cases, would enable the Institute to protect the profession by

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disinterested and authoritive investigation, which should result either in placing responsibility for a financial wreck, in the case of a great engineering undertaking, directly upon the engineer, or absolving him from such apparent responsibility and placing it where it belongs.

In my own line of work, and more particularly in power transmision, it is a fact that the very best of projects must sometimes go begging because the bankers in this community and those in Boston and elsewhere have been deeply impressed by a number of bad failures. Someone is to blame for this condition.

Some of the engineers connected with these cases have said to me that they wish the facts could be known, as they were being blamed for something for which they were not responsible. I wish that a court might be brought about by this Institute with adequate powers and resources. Suppose an engineer has been connected with a large enterprise which has proved a financial failure. Suppose he is not to blame and could establish that fact. Might it not be possible that we could afford him or his client an opportunity to have this question investigated and the responsibility determined?

On the other hand, I believe that some engineers have been inexcusably careless in their estimates. There are some men relatively prominent in this field, who, I think, have been directly responsible for failures due to hasty and inaccurate estimates, and I feel that they should feel the responsibility and suffer the punishment which follows it. I do not know how this can be worked out; I have jotted it down without much thought, but I feel that there should be some way of fixing responsibility in these cases. We are all more or less blamed for some of these failures, for which somebody else may be solely responsible, and I think this responsibility should be definitely fixed in every case of failure.

In this connection another thought: I think in enlarging its membership, this Institute would do well to go farther than most societies in investigating the standing of applicants for membership. For instance, the applicant for the grade of Fellow in the American Institute of Electrical Engineers must have been in the active practice of his profession for at least ten years, but it is not taken into consideration whether, during that time, his record shows that he has acted wisely or not. In our Society a man should be obliged to produce evidence in the form of letters from his clients, or otherwise, not only to show that he has practiced his profession for a specified number of years, but to show that his work has been well done.

As regards competition from manufacturers, the consulting engineer whose work lies in the electrical field has encountered, in recent years, increasing and very serious competition from manufacturers of mechanical and electrical equipment, who undertake frequently to perform for prospective purchasers of their apparatus, important engineering service, for which no charge whatever is made.

At the meeting of this Society on Jan. 16, 1912, C. C. Schneider gave us a most interesting account of a somewhat similar situation which some years ago confronted the consulting engineer whose specialty is the design of bridges, and he told us how practice in this department of engineering effort had been improved. Upon the same occasion I called attention to the competition to which the electrical and mechanical engineers are subjected by the existing unfair and, I think, improper practice of companies manufacturing electrical and mechanical equipment, and that statement I shall not repeat this evening, except to repeat the suggestion which I then made regarding the possible remedy, namely:

(1) The American Institute of Consulting Engineers, the American Institute of Electrical Engineers, and our other national engineering societies whose members undertake work of this character, should adopt a schedule of minimum charges so far as the service rendered can be classified.

(3) The companies manufacturing electrical apparatus, in furnishing estimates, plans and specifications relating to aggregations of apparatus constituting plant or equipment, should regard themselves as consulting engineers, and invariably should exact for the service rendered at least the minimum charge recommended for its membership by the engineering societies.

(3) Consulting engineers who secure from manufacturing companies such estimates, plans and specifications as I have referred to, should pay the manufacturing companies for them just as any unprofessional inquirer would pay under the plan suggested.

❖

By Samuel Whinery*

The practical questions we are considering tonight have a deeper significance, and a more important bearing upon engineering than might at first appear. When I speak of engineering, I refer to the broader definition of the word, which includes civil, mechanical, mining and electrical engineering and architecture.

Engineering is commonly spoken of as a profession. Possibly the strongest claim that can be truthfully made is that it is a quasi-profession, since it has no legal existence. But we like to speak of it as a profession and to believe that it is so, and we assume, for present purposes, that it is entitled by sufferance to be so called.

But whatever opinion we may hold on this point, the careful observer of present tendencies in engineering, industrial and commercial matters cannot fail to be impressed with the feeling that engineering, as a profession, is passing through a critical and dangerous period.

I speak now of *engineering as a profession.* The principles and practice of engineering will, of course, continue to grow in power and influence in the world. They must, necesarily, be always in the van of material human progress. The engineer, whatever may be his status before the public, or whatever may be his relations to his fellow engineers, and to other potent human agencies, will continue to exert a controlling influence in the material world. But the status of the engineer in the future will depend largely upon whether engineering shall develop into a well-defined profession or into a mere trade or vocation.

This question of the future status of the engineer is a fundamental one that must be answered before we can intelligently discuss such secondary topics as our relations to one another and to the public. If engineering is merely a trade or craft, it must take its chances in the hustle and competition of business like other crafts or trades.

The meaning of the phrase "a profession" is not as clearly and sharply defined as we could wish. The world

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has, in a measure, outgrown its original signification. Nor is it easy to frame a definition that satisfactorily fits the modern idea of a profession. Some of its characteristics are, however, well understood. One of these is that a profession is a vocation founded upon specialized educational training, the purpose of which is to supply disinterested counsel and service to others for a direct and definite compensation, wholly apart from expectation of other business gains.

Thus, the engineer who acts in a strictly professional capacity is bound to give his best service to his client, influenced by disinterested motives only, for a stated compensation, and wholly free from any expectation of ulterior or incidental gain that may result through the adoption of his advice or plans. To put it more briefly still, the professional function necessarily assumes the absolute divorcement of engineering from commercialism in all matters involving the engineer's relation to his clients and to the public.

This principle is recognized in other professions. The doctor may not engage in the manufacture and commercial sale of pills and at the same time practice medicine and prescribe his product for his patients. The lawyer may not, theoretically at least, accept a case on a contingent fee. In like manner the professional engineer may not prescribe or recommend devices, construction or enterprise in the commercial success of which he has a personal interest.

It is the violation of this principle which now threatens the destruction of the profession. There is today a strong tendency to combine the professional and the commercial aspects of engineering. So combined, they become simply a learned trade, having no more claim to professional standing than the business of the skillful and scientific plumber, who commonly designs as well as sells his product.

The large number and the notable successes of so called "engineering firms" and "corporations" that undertake important public enterprises from their inception to their operation, through all the stages of exploitation, design, financing, construction and operation, offer the most convincing evidence of the drift of the times toward the commercialism of engineering. The large number of able engineers whose main vocation is contracting, but who, at the same time, assume to maintain a professional practice and standing, is another very significant sign of the times.

We need not here discuss the intrinsic merits or demerits of these combinations, and we certainly have no desire or disposition to criticize those engaged in them. We need not even express an opinion as to whether these developments are or are not in the interests of the public or make for true progress in the world's development. We are simply considering their relation to engineering as a profession.

If, upon the whole, it shall develop that by such a combination of engineering and commercialism, public or private projects can be carried through more cheaply, conveniently and satisfactorily, and with equally good ultimate results, than by the separate employment of independent engineers, there can be no doubt of the final outcome. *Engineering as a profession* will cease to exist, and engineering knowledge, skill and ability will become simply one of the valuable commercial assets of business organizations.

If, on the other hand, it shall be developed, and the fact becomes appreciated by the public, that to secure the best results in public or industrial enterprises, the services of the independent, disinterested, professional engineer are essential, there is a possibility that engineering as a profession may not only be maintained, but, in time, placed upon a clearly defined and permanent basis. But such a professional status can never be attained unless engineers themselves desire it, and make a united effort to bring it about.

Among those here tonight, it is safe to assume that all believe in the possibility, as well as the necessity, of a profession of engineering, though we may differ as to its present status and the measures that are necessary to insure its permanence and usefulness.

While it is useful to discuss special incidents or phases of the present situation, the writer is impressed with the belief that something more elemental and radical is essential. In the first place, it is necessary that the boundaries and limits of the profession shall be distinctly marked out. There must be some way of distinguishing between those who belong to it and those who do not.

In this respect the profession of engineering is now anomalous. In naw, medicine and the ministry it is required that there shall be some public, formal recognition and record of a man's right to admission as a member of the profession, involving also the power to terminate that right. This is wholly absent in the engineering profession. Any man, regardless of his competence or incompetence, or of his moral character, may hang out his sign as an engineer, put a profesional card in the engineering papers and pose before the public as a member in good standing. So long as he does not violate the civil or criminal laws or trespass upon the accepted rules of morality that apply to all men in common, neither the state nor the profession can exercise any control over him. The public can only judge of his character and professional ability by his general reputation, just as it would in the case of an ordinary mechanic. There exists at present no power or authority, either in the state or the profession, to dispute his pretension or to publicly brand him as an imposter, and anyone bold or rash enough to properly characterize him may be prosecuted for slander. There is, in short, no such legal offence as engineering malpractice.

It may be said that membership in reputable engineering societies is a sufficient passport to good standing in the profession, and the reserved right to expel an unworthy member is a sufficient safeguard for the protection of the public. But admission to such a society is not a public notice in the official sense; and it is a rather singular and impressive fact that no man has ever, so far as I am aware, been expelled from any one of the leading engineering societies for incompetence or unprofessional conduct. Among so large a membership as these societies possess, it would be surprising if no one had ever merited such expulsion. The absence of such cases is doubtless due, not to any lack of a disposition to act, but to the fact that no positive, authoritative and comprehensive code of practice and ethics has been formulated upon which a conviction could be based.

The simple, cold fact is that, beyond vague impressions in the mind of the public and a fond fiction in our own minds, there is no adequate public or legal recognition of the *profession* of engineering. It is true that

our engineering schools confer various engineering titles upon their graduates, which certify to their scholastic attainments, but can do nothing more, particularly since a degree in a profession that has no legal standing cannot be regarded as carrying much weight.

If the situation here outlined be even measurably correct, the conclusion seems inevitable that the first and most important thing necessary to establish and maintain a profession of engineering is the public, legal recognition of the existence of such a profession and some measure of official control of its membership by the state.

Following or in connection with this, there must be a sufficient degree of organization or solidarity within the profession itself to secure coherence and general unity of action. In other words, there must be adequate internal control of the profession. One of the most important functions of this internal control will be to establish comprehensive standards of professional conduct, including the relation of its members to each other, to clients and to the public. Such a "Code of Ethics" may almost be said to be absolutely essential to the successful existence and usefulness of any profession. Whether formally reduced to writing, or existing by common consent, or the outgrowth of traditional accretion, every one of the professions has its code of ethics developed to a greater or less extent. It will, I think, be conceded, however, that among engineers such ethical rules of conduct are more unformulated, less clearly defined and more loosely applied in any other profession.

It is largely because of this condition that we are now discussing questions of detail, the answers to which should proceed, as a matter of course, from fundamental "Thou shalts" and "Thou shall nots" having the force and authority of a professional Decalogue.

If, for instance, it were accepted as a fundamental dictum that the engineer cannot both design a structure and become the contractor for its construction, nor have any indirect or contingent material interest in the enterprise beyond the performance of his professional duty and the collection of his professional compensation, a whole brood of troublesome questions of detail would almost settle themselves. Among other cases, engineers who undertake to carry out public works from their A to their Z, would be promptly disqualified as members of the profession, and their employees, in whatever capacity, would necessarily share their fate.

If it were definitely accepted and ordained that a man cannot pursue the business of contracting and, at the same time, practice as a professional engineer, another class of troublesome questions would be easily and definitely disposed of.

These illustrations are used without expressing any opinion as to the wisdom of adopting such edicts, and with no intention of casting disrespect upon those who would be affected by their adoption. We are not now discussing the wisdom, equity or propriety of these or other possible provisions of a proper code of ethics for engineers. These are matters for the profession at large to carefully consider and determine. I am here arguing only the proposition that *a* code of ethics is necessary to establish certain standards for professional conduct. It must be obvious, however, that, if engineering is to be established and maintained on a professional basis, there must be a well-defined demarcation between professional duty and incidental or contingent business interest.

It must also be obvious that whatever rules of conduct and practice a profession may consider necessary for the benefit and protection of the public, and for its own control and preservation, they must be adopted, promulgated and enforced in such a manner as to attract the attention and command the respect and obedience of its members.

It may doubtless be truly said that engineers, as a rule, do not wilfully violate well established rules of professional conduct. But how few such rules are well established and known to all? How few of them have been formulated at all? It is trite to say that, where there is no law, there can be no violation of law, and a law not backed up by enforcible penalties is a dead letter. Until engineers shall have enacted positive and clearly defined rules and standards of conduct, the present state of uncertainty, confusion and unsatisfactory conditions will continue.

In line with those thoughts, it is the writer's feeling that the only way to deal satisfactorily with these individual questions that come up under the head of Professional Relations, is to begin at the foundation and build up systematically a real profession of engineering. He conceives that the two most important steps to be taken would be:

First: To secure the legal recognition of engineering as a profession and the enactment of such statutory provisions as may be necessary for its maintenance.

Second: The authoritative adoption and enforcement, within the profession, of a comprehensive code of ethical rules and standards of professional conduct.

Until something like this is done, our discussion of professional relations may be able and interesting, and our conclusions wise and just, but, in the absence of any adequate authority and power, within or without the profession, to enforce these conclusions, they are likely to be futile.

I do not desire to appear in the role of a pessimist or alarmist in this matter. I am aware that many of my fellow engineers will consider the views here expressed as radical and unwarranted by the present situation. I may even be wrong in assuming that the great body of American engineers desire or think necessary any radical change in the present and prospective conditions of engineering. I know that there are not a few who believe that whatever changes are essential or good for the profession will come about through some process of crystallization or natural evolution. I do not find anything in the past history of the profession, in this country, at least, to warrant such a belief or to encourage such a hope. History and experience teaches us that real advancement in ethics, sociology or civil government can only be achieved by united and determined effort.

In view of all this, it seems to me that the time has come when engineers must give these matters careful and weighty thought, decide what it is desirable and proper to do, and take whatever action is called for without delay.

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Electrical-engineering Students in the technical schools of this country in 1912 numbered 8921, according to a compilation of statistics in the "Electrical World," Nov. 23, 1912. In that year 1496 graduated, bringing the total number of graduates during the past six years up to 18,318. The statistics for the six years past are shown below.

	1907	1908	1909	1910	1911	1912
Number of students.....	8929	9651	8670	9041	9515	8921
Number of graduates.....	1358	1501	1473	1545	1614	1496

Codes of Ethics for Engineers

Apropos of the proposed code of ethics recommended for adoption by the American Society of Mechanical Engineers and printed in our issue of Jan. 2, a correspondent calls our attention to the fact that codes of ethics have previously been adopted by the American Institute of Consulting Engineers and by the Pacific Association of Consulting Engineers. The former was printed in full in ENGINEERING NEWS of June 29, 1911, p. 795, and the latter in ENGINEERING NEWS of Mar. 14, 1912, p. 489.

The American Institute of Chemical Engineers has now before it for consideration a code of ethics drafted by a committee of the Institute. We reprint this code as follows:

Purpose of the Code:

To define the rules of professional conduct and ethics for the members of the Institute.

The Institute expects of its members:

1. That in all their relations, they shall be guided by the highest principles of honor.

2. The upholding before the public at all times of the dignity of the chemical profession generally and the reputation of the Institute, protecting its members from misrepresentation.

3. Personal helpfulness and fraternity between its members and toward the profession generally.

4. The avoidance and discouragement of sensationalism, exaggeration and unwarranted statements. In making the first publication concerning inventions or other chemical advances, they should not be made through the public press, but through chemical societies and technical publications.

5. The refusal to undertake for compensation, work which he believes will be unprofitable to a client without first advising said client as to the improbability of successful results.

6. The upholding of the principle that unreasonably low charges for professional work tends toward inferior and unreliable work, especially if such charges are set at a low figure for advertising purposes.

7. The refusal to lend their names to any questionable enterprise.

8. Conservatism in all estimates, reports, testimony, etc., especially in connection with the promotion of business enterprises.

9. That they shall not engage in any occupation which is obviously contrary to law or public welfare.

10. When a chemical engineer undertakes for others work in connection with which he may make improvements, inventions, plans, designs or other records, he should enter into a written agreement with regard to their ownership; and when it is subsequently found that such an agreement does not cover a point at issue, the following rules shall apply:

a. If a chemical engineer uses information which is not common knowledge or public property, but which he obtains from a client or employer, the results in the form of plans, designs or other records shall not be regarded as his property, but the property of his client or employer.

b. If a chemical engineer uses only his own knowledge or information or data, which by prior publication or otherwise are public property, and obtains no chemical engineering data from a client or employer except performance specifications or routine information, then the results in the form in inventions, plans, designs or other records should be regarded as the property of the engineer and the client or employer should be entitled to their use only in the case for which the engineer was retained.

c. All work and results accomplished by the chemical engineer in the form of inventions, plans, designs or other records, or outside of the field for which a client or employer has retained him, should be regarded as the chemical engineer's property.

d. When a chemical engineer participates in the building of apparatus from designs supplied him by a client, the designs remain the property of the client and should not be duplicated by the engineer or anyone representing him for others without express permission.

e. Chemical engineering data or information which a chemical engineer obtains from his client or employer or which he creates as a result of such information must be considered confidential by the engineer; and while he is justified in using such data or information in his own practice as forming part of his professional experience, its publication without express permission is improper.

f. Designs, data, records and notes made by an employee and referring to his employer's work, should be regarded as his employer's property.

g. A client does not acquire any exclusive right to plans or apparatus made or constructed by a consulting chemical engineer except for the specific case for which they were made.

11. A chemical engineer cannot honorably accept compensation, financial or otherwise, from more than one interested party, without the consent of all parties; and whether consulting, designing, installing or operating, must not accept compensation directly or indirectly from parties dealing with his client or employer.

When called upon to decide on the use of inventions, apparatus, processes, etc., in which he has a financial interest, he should make his status in the matter clearly understood before engagement.

12. The chemical engineer should endeavor at all times to give credit for work to those who, so far as his knowledge goes, are the real authors of such work.

13. Undignified, sensational or misleading advertising should be discouraged.

14. Contracts made by chemical engineers should be subject to the Code of Ethics.

For the administration of this Code of Ethics, a Committee on Ethics shall be appointed by the president holding office at the time of the adoption of this Code, to consist of five members; one appointed for five years, another for four years, another for three years, another for two years, another for one year, and thereafter, the president then holding office shall appoint one member annually to serve for five years and also fill such vacancies as may occur for the unexpired term. Three of these members shall be over forty-five years of age. The Committee shall elect its own chairman. The Committee on Ethics shall investigate all complaints submitted to them bearing upon the professional conduct of any member, and after a fair opportunity to be heard has been given to the member involved, shall report its findings to the Council, whose action shall be final.

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Vaccine for Immunization Against Typhoid Fever is to be supplied free of charge to local health officials throughout Ohio, by the Hygienic Laboratories of the State Department of Health, on application to Dr. T. R. Brown, bacteriologist in charge of the laboratory. Further information on the subject is quoted from a recent bulletin of the Ohio State Board of Health as follows:

It must be definitely understood that the vaccine is not to be used as a therapeutic or curative agent, but solely as a preventive measure. The treatment consists of three injections 10 days apart given subcutaneously with a sterile hypodermic syringe. The first two injections consist of 0.5 cc. each containing approximately 500,000,000 dead micro-organisms. The last injection of 1 cc. of approximately 1,000,000,000 micro-organisms. Subsequent to the first injection quite frequently a little discomfort such as headache, loss of appetite, etc., is felt for a short period of time. The subsequent injections usually produce little effect. If the injection is given properly there should be very little local reaction around the point where the needle is introduced.

The vaccine has been used in certain sections of the state rather extensively during the last few months, but its cost has in a measure prohibited it being used in large numbers of indigent cases, and it is particularly for the purpose of supplying this class of people that the State Board of Health has undertaken this very important work.

Track Elevation at Cincinnati, Ohio, is expected to make considerable progress during 1913. In November, 1910, a bond issue of $800,000 was approved by popular vote to pay the city's proportion of cost for the elimination of grade crossings. It is proposed to eliminate four crossings with these funds: Ludlow Ave. and the B. & O. R.R.; Hopple St. and the B. & O. R.R.; Rockwood and Delta crossings both of Eastern Ave. and the P., C., C. & St. L. R.R. Of these, Ludlow Ave. and Hopple St. are to have reinforced-concrete viaducts; the two crossings of Eastern Ave. and the P., C., C. & St. L. R.R. are subways, the railway being elevated. The Ludlow Ave. viaduct is now under construction and is about 40% completed. Plans have been made for the Hopple St. viaduct, but are being revised and work will probably commence on the structure early next summer. Work on the Rockwood crossing wil commence in the spring, and it is hoped to commence work on the Delta crossing also some time this year. Plans are also being made for the elimination of the crossing of Erie Ave. and the Indiana Division of the P., C., C. & St. L. R.R. in Madisonville. In this case the street will be carried over the railway tracks.

Operation of an English Producer Gas Supply Works

A paper entitled "The Generation and Distribution of Producer Gas in South Staffordshire" was presented before the British Institution of Civil Engineers, Dec. 10, 1912, by H. A. Humphrey. The following extracts have been taken from abstracts of the paper in the London *Times'* Engineering Supplement, Dec. 11, and *Engineering*, Dec. 13, 1912:

The South Staffordshire Mond Gas (Power and Heating) Co. was the first example of a company which gave, under Parliamentary powers, a supply of producer gas for public purposes. As finally passed by Parliament the Mond Gas Bill contained clauses prohibiting the sale of gas for domestic purposes or for illumination.

Area—The area covered was 123 sq.mi. in extent, and it included six corporations, 16 urban district councils, and three rural district councils, while there were 100 miles of railway, 106 miles of canals, and more than 2000 works which used heat or power.

In some respects the area of supply was not an ideal one. The works which required a supply of gas were sometimes clustered together, but there were barren spaces intervening, and frequently considerable lengths of main had to be laid in order to serve individual consumers. Competition from more favorably situated districts had considerably diminished what were once the principal trades, and the district was less a coal and iron producing center than formerly, although about three million tons of coal were still raised yearly, and some first-class steel and iron works had an important output.

Generating Station—It was decided ultimately that one centrally situated generating station would be best, and that the supply should be carried first to the northern portion of the area. Accordingly, a suitable site of about 40 acres, adjacent to railway and canal, was secured at Dudley Port, Tipton.

The unit of plant adopted was based on a capacity for gasifying 140 tons of coal daily, and consisted of eight Mond producers (one being a spare), together with the necessary plant for cooling, cleaning and compressing the gas; plant for the recovery of sulphate of ammonia and tar; and the machinery, comprising steam boilers, circulating pumps, electric-generating plant, motors and fans. The first unit of plant was started in February, 1905, and additions to the plant, now being made, would increase the present output by about 80%.

From the time that the public supply was first begun, in May, 1905, until the present date, there had not been a single stoppage of the gas supply from the station, and pressure had been maintained in the trunk mains throughout the whole period. Only twice had the gas supply been cut off from individual districts; the first occasion was to put in an enlarged main, and the second to couple up to another trunk main. In each case the stoppage was only for two hours.

Boilers and Producers—For each ton of coal gasified more than two tons of steam had to be supplied with the blast entering the fire-grate of the producer, and, although more than half the steam required was obtained from the system of recuperation by circulating water which was employed in the Mond producer plant, yet a considerable balance of steam had to be made up. It was usual, therefore, to drive the greater part of the machinery by steam, and in the present instance steam was raised for this purpose at 120 lb. pressure, and after passing through the various engines and pumps, where it did work, the exhaust steam was collected and mixed with the air supply to the producers. It was desirable that the boilers used should be capable of burning fine dust and small coal, which it was proposed to screen from the bulk supplied to the producers, and for this purpose the boilers had to be capable of working with forced draft. In order to equalize the station load as much as possible, the boilers were to be gas-fired during those portions of each 24 hours when the gas supplied to customers was comparatively small in quantity; and for part of each day coal firing and gas firing were to be carried on simultaneously.

A test lasting 40 hours with gas firing alone had shown a heat efficiency, as between calorific value of gas and heat in steam generated, of 79.1%.

The steam from the boilers was led to the various parts of the plant by ring mains, so that each steam-driven machine could be supplied through at least two separate lines of mains.

Since there is no gas storage as in ordinary illuminating works, the output of gas depends at all times upon the quantity of air forced through the producers. There are three blowers of the Roots type (two working and one spare), each being capable of delivering 6000 cu.ft. of free air per minute at a pressure of 28 in. of water gage when running at a speed of 100 r.p.m. These positive-pressure blowers can run under a wide variation of speed, but there is a limit below which it is not safe to attempt to run, for fear of stopping. If, therefore, the demand for air is reduced below a certain quantity, further regulation is obtained by allowing some of the air to escape into the atmosphere.

The eight Mond producers installed at Dudley Port had a diameter of 10 ft. measured inside the brick lining. Each producer was rated at 20 tons of coal per 24 hours, but the actual capacity depended partly on the quality of the fuel. With the slack used at present a producer could readily be worked at 50% above the rated output, and for considerable periods.

Recovery Works—The gas on leaving the producer passes through the superheaters, which are used as heat interchangers to raise the temperature of the incoming blast, and then enters the gas-collecting mains, each of which receives a supply from four producers. Each of the two mechanical washers is fitted with three electrically driven dashers for throwing up large quantities of spray, with the double object of cooling the gas by evaporating some of the water for raising steam and washing out the solid particles of dust carried over from the producers.

After the first cleaning and cooling the gas passes upward through one of the lead acid-towers where it meets the downcoming current of acid liquors. The ammonia in the gas is combined with the free sulphuric acid, forming soluble sulphate of ammonia. From the acid tower the gas passes through two, and sometimes three, gas-cooling towers in series to reduce the water vapor to a minimum. There are three steam-driven gas compressors, two being normally in operation. Each has a capacity of 9400 cu.ft. of free gas per minute, and, when supplied with steam at 120 lb. and running at 80 r.p.m., will compress this amount to a gage pressure of 10 lb.

No water escapes from any part of the plant until it has passed through a settling tank, 70x50 ft., in area, so that the flow is slow enough to enable all sediment to be deposited, while surface tar is prevented from leaving by partitions. The tar, collected from various parts of the plant and especially from the settling tanks, is run into tar eggs, from which it is blown to a tar-collecting plant. It contains 30% to 40% of water, to get rid of which it is run into large vertical vessels with steam coils and raised to a temperature of 80° C. while stirred.

Plant Pipes and Valves—A number of cross-connecting pipes and valves are required for the plant. Some of these valves are fitted in mains 5 ft. 6 in. in diameter, and it is a matter of great importance that the design of these valves should be such that they can be readily operated, in spite of deposits of tar and hard carbon, which may have formed during a long period of idleness. A hinged quadrant plate, carrying a toothed rack, can be operated by a chain and wheel, which rotates a pinion geared to the rack. This plate is pierced by a hole of the required diameter, which can be brought to coincide with the bore of the pipe, while, by rotating the quadrant plate, the solid portion can be used to blank off the pipe. The flanges between which the quadrant plate is movable can be forced apart by strong setscrews, and poke holes are provided so that carbon deposits may be cleared off the quadrant plate. By this means the plate can be freed so that it is moved easily from one position to another, and can then be gripped again in its new position.

Mains—For safety against subsidence, and in order to reduce to the minimum the number of joints at which leakage might occur, steel pipes appeared desirable for the distributing mains, but their probable life required consideration. Stated briefly, the conclusion arrived at was that in all cases where steel pipes had had a comparatively short life there had been some special and preventable cause. The mere coating of pipes with such material as Dr. Angus Smith's solution is quite insufficient to protect them, and a thick coating of bituminous material, strengthened by layers of Hessian cloth, was recommended and adopted. Eight years is perhaps not a very long term of experience, but as steel pipes which have been laid for this period have been examined and show absolutely no signs of any attack, there is every reason to believe that the system adopted will prove entirely satisfactory.

For the larger trunk mains the cheapest pipes obtainable were the Mephan-Ferguson locking-bar pipes. One of these pipes, 28 ft. long, can be made in about 20 minutes. The

thickness of locking-bar pipes is ⅜ in. for 36-in. mains, $\frac{5}{16}$ in. for 3-in. mains, and ¼ in. for mains of 30 in. to 18 in. in diameter. All pipes supplied to the company were tested hydraulically to 300 lb. per sq.in., and only a very small percentage of pipes showed any leakage. About 13 miles of locking-bar pipes have been laid in South Staffordshire and have given satisfaction. For mains having diameters between 15 in. and 4 in., inclusive, lap-welded steel pipes, having their ends screwed with a vanishing thread and joined by a collar wth a similar screw thread, have been used with success. When the joints are screwed up with a graphite compound they become absolutely tight. Up to the middle of September, 1912, the length of mains laid was 29.45 miles.

Originally the steel mains were coated once with asphalt, then wrapped round with Hessian cloth, and afterward again coated with asphalt, the result being to produce a coating ¼ in. thick. Pure Trinidad asphalt was first used, but owing to its expense a cheaper substitute was subsequently employed, made of pitch, bitumen, sand, and creosote oil, these constituents being mixed in the proportions necessary to give the necessary elasticity and freedom from brittleness. The mixture is applied hot, first over the pipe, and then over the Hessian wrapping.

The provision for draining the mains has to be more extensive than in the case of an illuminating-gas supply, and cast-iron drainage boxes are inserted at numerous points, determined by the lowest levels and inclines. The tarry water which collects in these boxes is emptied periodically, either by the pressure of the gas or by pumping. This work entails the use of a horse-drawn cart fitted with a pump.

The pressure chosen for the South Staffordshire mains was 7 lb. per sq.in. at the compressors, and this was fixed partly because all the steam used to drive the compressors could be utilized, along with the exhaust steam from the pumps, etc., for heating the blast for the producers; but the author is convinced that in the future higher pressures, up to 60 lb. per sq.in., will be used.

For most purposes it is necessary to reduce the pressure of the gas used in a consumer's works to a few inches of water gage, and for this purpose a pressure reducer and regulator is fitted at the entry to each consumer's premises, so as to insure a supply at a lower and constant pressure. Wherever the quantity of gas supplied is sufficient to warrant the expense a small gas holder is provided, the rise and fall of which is operated by the high-pressure supply, so as to maintain the gas in the holder at a constant pressure.

Operation—A large number of fuels have been used successfully in the producers in the course of seven years, but the fuel which is employed almost exclusively at the present time has an average calorific value of 11,600 B.t.u. per pound of coal. About 3300 tons of coal were being gasified per month in the first half of 1912, and the monthly outut of byproducts was approximately 120 tons of sulphate and 280 tons of tar. These figures have since increased.

The maximum output of gas in a typical week reached 368,700 cu.ft. per hr., all this being supplied to outside consumers, while the minimum taken by consumers was 195,000 cu.ft. per hr. The peak of the load has since reached 1,000,000 cu.ft. per hr.; in fact, the plant has gasified at the rate of 200 tons per day, although only designed for 140.

A very constant calorific value is maintained, due to the large size of the producers, with their big store of internal heat, and to the fact that the producer blast is always maintained saturated to the same degree.

The commencement of the gas supply occurred about the time when suction producer plants were beginning to be employed largely. It is, however, a fact worthy of record that practically every gas producer situated near the company's mains has been shut down, the owners finding it more advantageous to take supplies from the gas mains. From this cause 45 producer-gas plants have been thrown idle, 20 of these being suction plants and 25 pressure plants.

The blowers, cleaning fans and gas compressors are run for six weeks continuously day and night, and are then changed over for examination or overhauling. The gas engines are run continuously for a similar period, except that once each week there is a short stoppage of about one hour, while the ignition plugs are cleaned. The circulating pumps are run for three weeks continuously, when they are stopped for removing any tar from the valves. Most of the electric motors run continuously for much longer periods, and are only stopped when examination shows that there is some defect. The gas producers run continuously for two years, and then in rotation each producer is put out for examination; only slight repairs have ever been found necessary. Also every two years the superheaters are cleaned out, the dust and carbon deposit being removed; and in starting again care is taken to make hotter gas than usual, so that the superheaters shall be heated before any sticky carbon deposits can be formed upon their surface. The mechanical washers run three years before closing down for repairs, and one of the two gas-collecting mains is cleaned each Bank Holiday, so that each main is cleaned about every six months. The acid towers run two years in succession, and are then changed over so that any repairs to the lead work can be made. During the seven years of operation it has not been found necessary to change over the gas-cooling and air-heating towers. Steam boilers run for three months at a time, and are then cleaned, and the sulphate evaporators work for one year before the lead steam coils need repair. These evaporators require to be relined with lead every three years.

Results—The paid-up capital of the company at the end of the year 1911 was $2,120,015, which included $462,255 of debenture stock carrying interest at 5%. The expenditure might be divided, roughly, as $1,474,365, spent on Parliamentary expenses and central-station plant, and $645,650 on the distribution mains, etc. The capital spent on the gas mains was a large portion of the total, and this was accounted for by the fact that the mains were far in excess of the requirements of the first unit of plant erected. The additional plant now to be added, to increase the output by 80%, was estimated to cost only $175,000, and larger additions could be made before the gas mains would be working at their maximum capacity.

The cost per 1000 cu.ft. of gas manufactured, including general charges and debenture interest, less the amount realized by byproducts, was 2.574c. per 1000 cu.ft. The estimated cost was 1.6174c. with debenture interest. For the year 1911 there was a gross trading profit of $44,280.

The promoters of the company expected to obtain better prices for the gas than those realized, but partly because of the advent of the suction producer plant, and also owing to the difficulties of introducing an entirely new thing requiring new methods and new experience for its proper use, the schedule of prices has had to be lowered in order to render the supply more attractive to consumers. It soon became apparent that the only way to make real progress was to train an efficient staff who could undertake investigations in each individual case, and, where necessary, design the furnaces or other plant required, prepare working drawings and estimates, undertake the supervision of the building work, and, finally, start the plant and train men to work it.

The present scheme provided a supply for manufacturing works only, but if in future undertakings of this nature Parliament could remove the prohibition against supplying for domestic purposes, a powerful inducement would be offered to private companies or municipal bodies to embark on a supply of cheap fuel gas. Granted that there were difficulties in supplying areas where the streets were already congested with pipes, as in large cities, yet a beginning might be made in every "garden city" and in many of the smaller towns. As the average price at which Mond producer gas was now sold was only 3.50c. per 1000 cu.ft., and as the heating value of the gas was one-quarter of that of town gas, the supply was equivalent to lighting gas at about 14c. per 1000 cu.ft.

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A Joint Outlet Sewer from Pasadena, Calif., to the Pacific Ocean, with branch lines as needed to connect the 17 cities and towns in the San Gabriel Valley, is under consideration by a voluntary body named the Trunk Line Outfall Sewer Commission. W. J. Carr, City Attorney of Pasadena, assisted by William Hazlet, of South Pasadena, is drafting a legislative bill to authorize the project. It is stated that engineers Olmsted & Gillelen, of Los Angeles, have made a report on the project. The utilization of treated sewage for irrigation purposes is talked of as a possible large source of revenue. The project, it may be inferred, is at yet in an early tentative stage.

The Economic Prizes for 1912, offered by Messrs. Hart, Schaffner & Marx, of Chicago, have been awarded as follows:

Class A. The first prize of $1000 to Albert H. Leake, 170 Glengrove Ave., Eglinton, Ont., Canada, Inspector of Technical Education for Ontario, for a paper entitled "Industrial Education, its Problems, Methods and Dangers."

The second prize of $500 to Harry Edwin Smith, A. B., A. M., Depauw University, 1906, Ph.D., Cornell University, 1912, Instructor in Economics, Cornell University, Ithaca, N. Y., for a paper entitled "The United States Federal Internal Tax History from 1861 to 1871."

Honorable Mention to Glover D. Hancock, A. B., William Jewell College, 1898, A. M., 1899, Ph.D., University of Wisconsin, 1908, Professor of Economics and Political Science, Washington and Lee University, Lexington, Virginia, for a paepr entitled "History of the National Banking System in the United States."

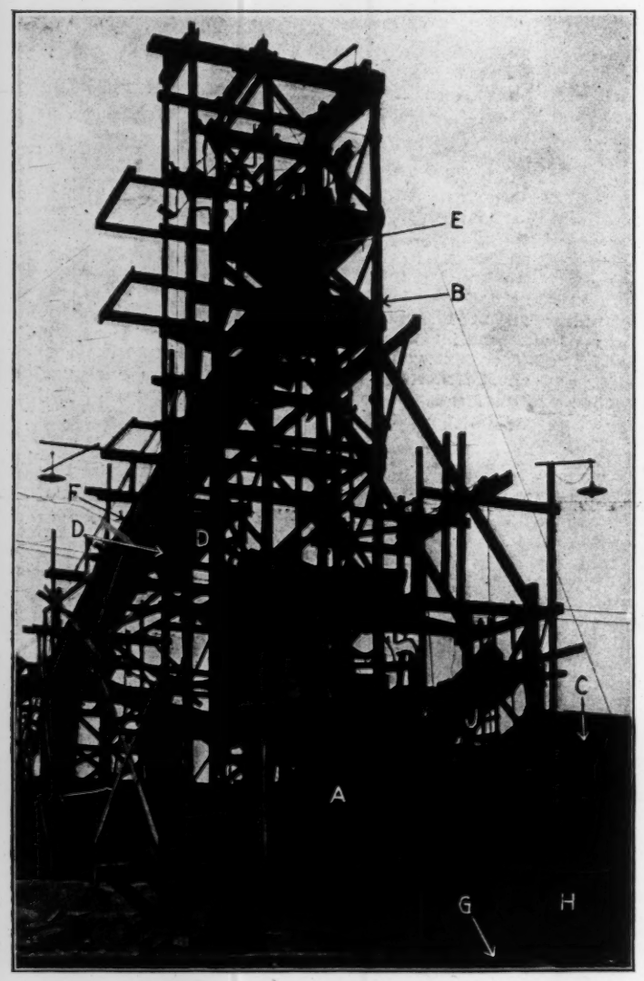
Class B. No papers were deemed worthy of award.

FIELD AND OFFICE

A Portable Plant for Mixing and Distributing Concrete

The distribution of concrete to the forms by means of inclined chutes or spouts from stationary elevating towers is now a very general practice, but we illustrate herewith a recent modification in which the tower and the concrete mixer are portable so that one plant can serve work covering a considerable length or area.

The plant is shown in the accompanying cut. It consisted of a standard-gage flat car equipped with a 1-yd. concrete mixer *A*, an elevator tower *B*, and a hoist house *C*, with electric motor for operating the mixer and elevator hoist. The tower was about 50 ft. high, and was placed at one end of the car, with guides so arranged that the skip *D* could travel past the end of the car and be in a position low enough for charging by gravity from the mixer. The skip was of 30 cu.ft. capacity, and delivered its contents automatically into a two-way discharge hopper *E*, placed in the tower. From this the concrete was delivered to the distributing chutes. Below one side of the car was a charging skip *F*, which was long enough to receive the contents of a Koppel 1½-yd. steel dump car, of the type shown at *G*. This skip was raised to deliver the material to the fixed charging hopper *H*, from which it was charged into the mixer. The dump cars ran on a double-track narrow-gage industrial track extending from the portable mixer plant to a double-track standard-gage siding; this siding had three cars of bank slag on one track, while on the other track were two cars of sand and one car of cement. The double-track narrow-gage line, with a switch at each end, extended between these two lines of railway cars, and on it were operated six of the dump cars. The bank slag and sand were loaded first into Lightbody unloaders, the correct amount for one batch being put in each. The narrow-gage car was then moved to receive the bank slag first, then the cement, and finally the sand. It was then pushed up to the loading or charging skip *F*, and dumped, as described above.



A Portable Concreting Plant, with Mixer and Elevator Tower Mounted on a Flat Car

When it was desired to move the plant, the chutes were disconnected and a locomotive shifted it to the desired position. The chutes to the forms were again connected, and concreting was resumed. This saved the trouble of dismantling and reërecting the tower as soon as all work within its radius of action had been completed. The trestle which carried the chutes had to be moved with each move of the mixer plant. The work extended over a length of nearly 900 ft., and the plant was located at six different points during the progress of the work.

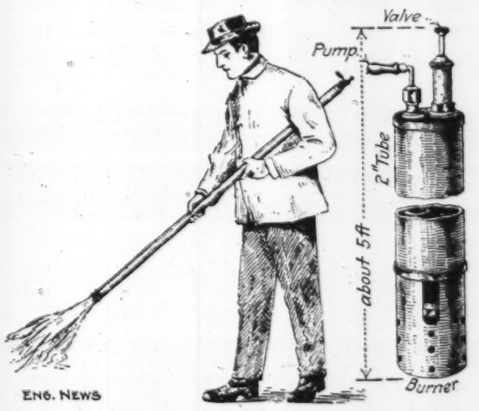
This plant was used in the construction of foundations and retaining walls for a new furnace for the Brier Hill Steel Co., of Youngstown, Ohio, and was designed in accordance with the ideas of B. R. Shover, Superintendent. The plant was purchased from the E. J. McHarg Co., of Binghamton, N. Y., which sublet the contract for the tower and skips to the Acme Equipment & Engineering Co., of Cleveland, Ohio. Mr. Shover states that the total amount of concrete was about 25,000 cu.yd. As much as 48 cu.yd. of concrete per hour was placed with this plant, while for several days the work averaged over 300 cu.yd. per day. A plant of this type is considered to be especially adapted to concrete work on railway construction or improvement.

A Gasoline Torch for Thawing Pipes and Melting Snow at Switches

In clearing snow and ice from switches, frogs and interlocking plants, the Chicago Great Western Ry. has had satisfactory results with a hot-blast gasoline torch, particulars of which have been furnished us by C. G. Delo, Engineer of Maintenance of Way. This device consists of a 2-in. tube of heavy brass, about 5 ft. long, fitted with a burner at one end and with a gasoline valve and pressure pump at the other end. A controlling valve on the inside regulates the flow of fuel, so that the

torch can be used in any position. With the air pressure and the special burner there is much greater heat and volume of flame than in any ordinary gasoline torch; the flame has a length about 12 in., but its size can be regulated by means of the valve. It will burn equally well whether the torch is pointed upward or downward. The tube holds about 3 qt. of gasoline, or sufficient for three hours' use. The weight is about 7 lb.

The device is shown in the accompanying cut. It is applicable to various other purposes, such as thawing



GASOLINE TORCH FOR THAWING PIPES, MELTING SNOW, ETC.

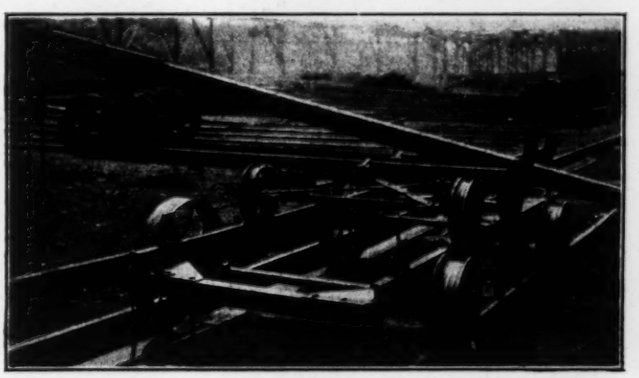
frozen water pipes and hydrants, taking the frost out of the ground for excavations, burning weeds, burning off paint, heating metal surfaces, etc. For foundry work, it is said to be superior to the ordinary blow torch for skin drying and baking sand molds. This hot-blast tubular torch is made by the Turner Brass Works, Sycamore, Ill., and is handled also by the Specialty Sales Co., 1307 Norwood St., Chicago.

A Rail-handling Machine for Rail Renewal

In rail-renewal work a large number of men are required, as a rule, to handle and place the rails, but several railways are now using a machine for handling the rails, thus effecting a considerable reduction in labor force and cost. This machine, which is shown in the accompanying cut, is built by the Q. & C. Co., of Chicago and New York. It consists essentially of three superimposed trucks. The bottom truck has a pair of longitudinal sills consisting of steel rails, upon which travel the double-flanged wheels of the second truck. This latter has a pair of rails at right angles to the track and extending some distance beyond it upon one side. Upon this transverse track rides a small truck with four double-flanged wheels, bearing the pivoted fulcrum support of a long lever whose short end carries a chain with rail tongs. As the fulcrum is pivoted on the truck the lever can be swung around in a horizontal plane to any desired position.

The machine is mounted upon four wheels; two of these are double-flanged wheels which ride on the line of rails which have not been changed or which have been relaid; the other two are flat-tired wheels which run on planks laid inside the line of the rails which are being renewed. The old rail may be pushed out of place, or the rail tongs may be attached to the rail, which is then raised by the lever, and the top truck is run out on the projecting track to deposit the rail on the roadbed. The tongs are then attached to a new rail, and the lever truck is run back to bring the rail in position over the ties. The rail is then lowered, being shifted longitudinally or "heeled" against the adjacent rail as required by moving the middle truck upon its rails. A rail-clamp, operated by a hand lever, is provided to hold the machine in position. This is shown between the double-flanged wheels. The machine is easily pushed along the track by three men, and it can be removed from the track quickly when necessary to let a train pass.

On the Mobile & Ohio R.R., it is stated by Sam Cheatham, roadmaster, only six men are required to handle 85-lb. rails with this machine, while otherwise 12 men would be required to carry the rails with rail-tongs. In rail renewals, a gang of 24 to 25 men with the machine is used, while to lay the same number of rails per day without the machine a gang of 32 to 35 men is used. For the Queen & Crescent Route, W. J. Edwards, roadmaster, has reported that seven men with the machine can lay as much rail as 12 men with the ordinary rail-tongs, provided that care is taken in distributing the new rails along the roadbed. With the machine the work is done more easily and causes much less strain upon the men. On high banks, where the rail is at some distance from the ends of the ties, these rails may have to be rolled up the slope to a position where the machine can reach them, but ordinarily this is not necessary. On the Kingston & Pembroke Ry. (Canada), we are informed by J. A. Irvine, engineer, formerly 14 men were used to pick up the new rail from the side of the track, carry it into place and heel it against the rail previously placed. With the machine, only eight men are now used, thus saving six men. The eight men at the machine are distributed as follows: 3 men on the lever to



RAIL-HANDLING CAR FOR USE IN RAIL RENEWALS

lift the rail; 2 men (one each end of the rail) to hold it from swinging when lifted up by the machine and to place it against the rail previously laid; 1 man to clamp the rail tongs to the middle of the rail, and 2 men to bring forward and place the boards on which the two flat-tired wheels of the machine run. The progress of the machine is dependent on how fast the spiking and fastening of the joints is kept up as the machine moves ahead. The saving on this road is from five to six men per day at $2 each.

Night Soil Incinerating Furnace at a Contractor's Camp

By Arthur W. Tidd*

The new 500-million-gallons-daily Catskill water-system for New York City, now being built by the Board of Water Supply, necessitates that construction work shall be carried on from the Ashokan Reservoir in the Catskill Mountains to New York City, a distance of approximately 100 miles. Throughout the whole length of the line a sanitary control is exercised, under the supervision of sanitary experts employed by the Board of Water Supply, over the housing and living of the laborers employed on the work and the disposal of all wastes.

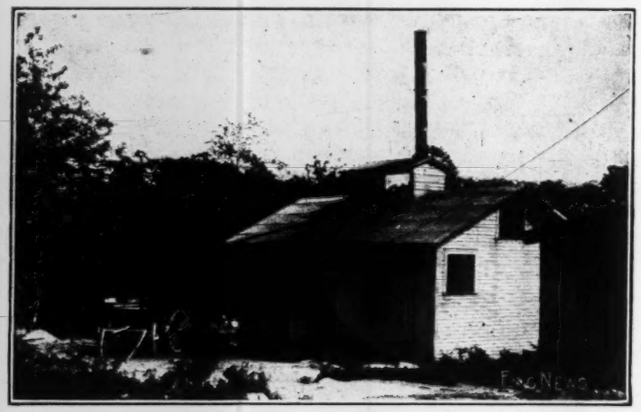


Fig. 1. Combined Night-soil Incinerating Plant and Closets, Hill View Construction Camp, New York City Board of Water Supply

Clauses are inserted in the specifications of each contract placing upon the contractor the duty of carrying out the provisions required for proper sanitation and specifying in many cases just what these provisions shall be. One of these is the provision that buildings for the sanitary necessities of all persons employed on the work shall be provided, and that all excreta shall be incinerated daily.

The incinerating furnace and accompanying equipment used on Contract 30, the Hill View Reservoir, are described in this article. Camp Hill View is located on nine acres of leased land adjoining the site purchased by the city for Hill View Reservoir. The camp is in the city of Yonkers and just north of the northern limit of New York City. The contractor is the Keystone State Construction Co. Fig. 1 shows a view of the incinerator house, and Fig. 2 shows a plan and section of the house and details of the incinerator.

For the use of the laborers on the work, pan closets, with doors, well built, but light enough to be readily moved about as needed, are provided. The pans are made of heavy galvanized iron about 15x18 in. by 8 in. deep, one to each closet.

For the camp the four corners of the incinerator house are partitioned off into independent closets, entered only from the outside, two for the men having six seats each, two for the women having two seats each. The galvanized pans are used here also, being removed from the back of the closets on the inside of the building as indicated in cross-section of the building shown in Fig. 2.

The incinerator house is 16x27 ft. 4 in. in plan, of wood, with a concrete floor, Amatite roofing, well lighted, ventilated and screened. The furnace is of the grate-bar type, although old 60-lb. steel rails from the work are cut up to make the grates instead of using the commercial grate-bar. It is 5 ft. 4 in. by 9 ft. in plan, 4 ft. high, built of brick, and has two ovens with hinged flat sheet-iron covers opening into a tight stack through which all gases and smoke pass off. Below each oven is an ordinary firebox in which a soft-coal fire is maintained until incineration is complete.

The pans are collected by wagon daily from the closets around the work by one man, who takes out the used pan, leaves an empty one in its place and cleans out whatever mud and rubbish has collected on the floor of the closet. Sawdust from a sawmill operated on the work is sprinkled about ½ in. deep over the bottom of the pan. The pans in the incinerator house are emptied daily, cleaned and replaced. The pans are emptied into the ovens just as they come from the closets, no materials of any kind being added to aid destruction. The small amount of ash remaining from the preceding day's run is sufficient to prevent the semi-liquid mass from working down through between the rails. After the ovens have been charged, the fires are started and maintained until incineration is complete, from 6 to 12 hr. being required for a full charge, depending upon the percentage of liquid matter. The pans, after having been emptied, are washed with a stream of water and turned upside down to dry. They may be seen at the left of the

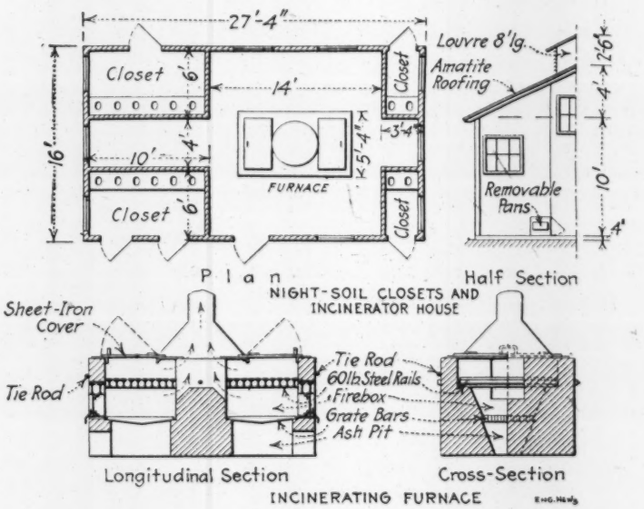


Fig. 2. Plan and Details of Combined Night-soil Incinerating Plant and Closets for Hill View Construction Camp

building in Fig. 1, washed and ready to be distributed. A garden hose and nozzle with city pressure is used for washing purposes. The two 6-seat toilets, the furnace and the floor of the building are also thoroughly washed down with the hose each day. One man who, except in the busiest season of the year also makes the collections around the work, charges the furnace, cleans the pans and building and starts the fires.

*Assistant Engineer, New York City Board of Water Supply, 215 Kimball Ave., Yonkers, N. Y.

About two tons of soft coal per month are burned, and it is noticed that the best economy is obtained by using as large a proportion as possible of the large pieces of coal. The rails will last about six months under average summer conditions. All the excremental matter is incinerated in the furnace. The waste water from kitchens, wash houses, etc., is discharged into a sewer, and the garbage, empty cans and general camp rubbish, which are also collected daily, are burned in a large Woodruff pit.

The contractor's force ranges from about 200 in the winter to 700 in the summer, practically all living in the camp in the winter and from 400 to 500 in the summer. There are some 16 closets on the work and in the summer about 30 pans are incinerated daily. Thirty pans taxes the capacity of the ovens to the limit, but the firebox is of ample size.

The first furnace of this general type to be used on the Board of Water Supply work was in 1909, when several small ones were put into service on Contracts 17 and 18 (American Pipe & Construction Co., contractors), in accordance with the ideas of David Whitmer, managing engineer for the contractors, and David S. Flynn, M. D., of the sanitary bureau of the Board of Water Supply. Ordinary grate-bars were used at first, but they were short-lived, and after experimenting with many different commercial bars old steel rails were given a trial. They have proved to be eminently satisfactory. The design of the building originated with L. C. Brink, of the Pittsburg Contracting Co.

The large double furnace described in this paper, operated without a watertight oven, was a development resulting from the ideas of Henry Delaplaine, chief engineer of the Keystone State Construction Co., contractors on Contract 30; Chas. E. Wells, division engineer for the Board of Water Supply, and David S. Flynn, M. D. It was built in May, 1910. Wood was used at first for fuel, and the firebox was practically equal in area to the oven, but the results were not altogether satisfactory, and the firebox was then rebuilt for burning coal, as shown in the drawings, with the reduced grate area for concentrating the bed of coals, and the sides widening out above to the full area of the oven.

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The Stock System of a Structural Shop

By F. Tissington*

One of the most important features in any bridge or structural works is the handling, manufacturing and dispatching of contracts expeditiously. Many contracts are let on a time basis, and frequently the price is a secondary consideration to time of delivery. It is, therefore, imperative for the works to adopt any schemes that will enable them to carry out work in the shortest time possible.

The passage of any contract through the shops can be subdivided into several stages; as a rule the stage occupying the largest portion of the time available is that caused by waiting for the material. Therefore it is a great advantage to be able to say at a minute's notice what stock material is available for a particular job, so that a fairly close estimate may be made of the time required to carry out the particular work asked for.

*Chief Draftsman, MacKinnon, Holmes & Co., Ltd., Sherbrooke, Que.

Most of the larger works can afford to run an elaborate stock system, costing quite a large amount of money in the aggregate, but perhaps only amounting to a small percentage on the annual turnover. But it is impossible for the smaller works to attempt a similar scheme, as the standing charges for running the system would be excessive. In this article the writer proposes to describe a stock-keeping system which is neither elaborate nor expensive, yet has answered the purpose exceedingly well, and as far as can be judged has brought about various economies besides doing away with a good deal of worry and trouble.

At the works in question the stock yard is not covered in, and with heavy falls of snow in the winter months it was found quite impossible (before the stock system was started) to say what stock was available. During the summer months the practice had been for one of the staff to take a rough stock list for a particular job. Work going through in the ordinary way would possibly be held up for an odd bar or two in order to complete the job, and this meant buying from somebody else at an enhanced price or waiting for the ordinary delivery from the mill.

Most systems either have too much or too little red tape, and it is usually difficult to strike the happy medium. It was therefore decided not to make any hard-and-fast rules until the scheme had been tried out, but no alterations were to be made in the original scheme except after consultation with the other people concerned.

The Stock Card-record

The material handled consisted principally of I-beams, channels, angles, plates; there were also small quantities of rounds, tees, and small flats. The I-beams and channels running into rather a lot of weight per foot in most cases, and being of comparatively small value in short lengths owing to the few chances of using them up again, it was decided to treat them more carefully than the plates, angles, etc., as the short ends of the latter easily work up into cleats, gussets, and packings, almost down to the last inch.

The following limits were therefore made in keeping the stock:

I-beams and channels.....all lengths;
angles.....15 ft. long and over;
tees.....15 ft. long and over;
universal mill plates and small flats...
...10 ft. long and over;
sheared plates.....stock sizes only.

The whole scheme depended on starting with an accurate stock list of what was in the yard within the range of the limits fixed. This was obtained at the annual stock-taking without incurring additional expense. The entries were made on cards (printed on both sides) set out as shown in Fig. 1.

It will be noticed that, at the head of the card, space is left for the insertion of any stock material that may be on order but not yet delivered. As soon as such material arrives, the entry is crossed out on the top portion of the card and carried below the heavy line into the columns indicating that this material is actually in the yard.

A second card may be used for the balances left over after the stock bars are once cut. This keeps the first

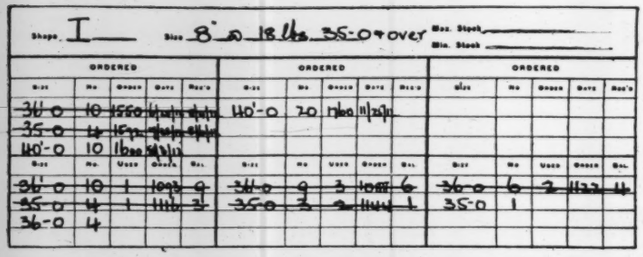

FIG. 1. STOCK CARD
(Back has same ruling, but no head)

card clear of anything except ordered lengths, and it is therefore possible to tell more rapidly what stock there is of a certain section. On this second card there is no need for the insertion of the lines for ordered material, and therefore the whole space can be taken up with the columns required for material in stock.

It was found with beams and channels that a subdivision after the following manner was useful:

First card: Ordered lengths 35 ft. and upwards.
Second card: Lengths from 20 ft. to 34 ft. 11 in.
Third card: Lengths from 5 ft. to 19 ft. 11 in.
Fourth card: All lengths under 5 ft.

By means of these subdivisions it was possible to pick out a length very quickly to cut from.

After the scheme had been in operation a short time it was found that quite a large stock of short lengths of beams and channels which had been looked upon principally as scrap was being used up, and thus quite a considerable saving was effected.

THE CUTTING-LIST CARD

BEAMS AND CHANNELS—The drafting room was made responsible for the cutting up of the beams and channels. A cutting-list form as shown in Fig. 2 was used.

MacKINNON HOLMES & CO, LIMITED.
CUTTING LIST. 52. Stock Material. Date Nov 28th 1912

ORDER	No. Pcs.	SECTION	Cutting Length	MATERIAL TO BE USED	REMARKS
1639	4	L 8"x8"x1⅛"	6'-10	One 7'-0 One 7'-6" One 13'-9	Cope.
1712	2	I 10"x25#	33'-4	Two 36'-0	
"	1	I 6"x12½#	9'-0	One 9'-4	Bevel cut.
"	1	L 12"x12"x⅞"	8'-9	}	
"	1	do.	9'-3	} One 40'-0.	Notch one end.
"	2	do.	9'-9	}	

FIG. 2. CUTTING LIST

This was entered up from the bill of material. The cutting lists were numbered in sequence, the number being quoted on the material bill.

No changes from the cutting list were allowed to be made in the shop unless the foreman obtained permission from the drafting room, as otherwise a bar might be substituted which had been put aside for another order.

As far as possible current contracts were worked in together, to cut up stock bars to best advantage.

The cutting lists are issued in triplicate by the office to the foreman; one copy for his own use and reference, the second for the yard man looking up the stock, and the third to the man working the saw.

On the cutting lists were noted any special bevel cuts, coping, etc., so that the saw operator asked for markings for a bar calling for special cuts other than square. This relieved the foreman of a considerable amount of worry and trouble, and enabled him to get his stock bars in and cut up ready for the markers by the time the templates were made.

ANGLES AND PLATES—The foreman made out the other lists (for angles, plates, tees, etc.) for the man handling the stock; the men operating the shears and angle cutter made up the cutting lists as they went on by simply stating how many stock bars or plates were used for a particular contract and giving the balances left over.

THE OFFICE AND SHOP PROCEDURE

Briefly the operation of the scheme is as follows:

On receipt of an order the drawings and bills of material are prepared in the usual way, and if any I-beams or channels are included in the job a cutting list is made for them. This list states the lengths required, what stock bars they are to be cut from, and what special cuts are to be made. The man in the drafting office who prepares this list makes an entry in pencil on the stock card against the particular lengths proposed to be used; this is done in pencil to avoid making alterations in case the bars cannot be turned up and changes have to be made, and at the same time to obviate any risk of using the same bar for two different contracts.

The whole of the lists and drawings are then sent to the foreman, and he issues the stock-man's list in plenty of time to allow him to keep the men at the machines supplied with material. When all the material has been sent in, the list is returned to the foreman. The machine men then proceed to do their part, note any alterations made, and on completion of the work covered by each list they hand this list back to the foreman.

Returning these lists to the foreman keeps him acquainted with the progress of this part of the work. As soon as he has looked it over, one of the copies is sent back to the office marked completed, and then the pencil entries on the stock cards are put in permanently with ink, any alterations necessary being made as noted on the lists.

Cutting lists for angles and plates are also sent daily to the office of work completed, and these are entered up as soon as received. Thus it is possible to tell at any time exactly what stock is available to make a new job.

This scheme has been in operation now for about six months. Although some little trouble was experienced at first, owing to the men in the shop not recognizing the need for accuracy, very little trouble is being found at the present time. Only occasionally is there any need for changing cutting lists.

It is, of course, possible that this idea would not suit all works, but with slight modifications to suit existing circumstances the author has no doubt about the efficiency and economy to be obtained by the use of such a system.

Shop Painting of Steelwork

Defective shop painting of bridge and structural steel was criticized recently by a committee of the American Railway Bridge and Building Association (see ENGINEERING NEWS, Nov. 21, 1912, p. 968). Similar criticism and suggestions for better methods of procedure were given before the Maintenance-of-Way Master Painters' Association by O. F. Dalstrom (Bridge Dept., C.

& N. W. Ry., Chicago, Ill.). Extracts from his paper follow:

It is practicable to dispense with shop painting when the rolling, fabrication and erection are all completed within a short period, and provided the painters follow close behind the erectors. This would apply to small bridges, viaducts, signal towers, and the structural steel that enters into the construction of freight sheds, shop buildings and yard equipment. But in all large structures the fabrication and erection cover such an extended period that the shop coat is imperative.

The objections to shop painting can be grouped as follows: painting on improperly prepared surfaces; painting under improper atmospheric conditions; painting done by unskilled workmen, frequently without competent supervision; difficulty of maintaining thorough inspection of other shop work, concealed by the paint; difficulty of handling freshly painted material.

When the steel comes from the mills it is covered with mill scale, much of which clings to it through the entire process of fabrication. By the time it has reached the paint shop there will be found in addition, rust, oil, grease, dirt and usually moisture. It is not practicable to maintain a dry surface in damp weather, and paint applied under such conditions can have no strong adhesion to the metal. The film of moisture would be inclosed under the paint, the resulting corrosion further loosening and breaking the continuity of the protective coating. Very cold weather is not favorable for obtaining a uniform and unbroken coat. Exposure to the hot sun tends to produce blisters, and (in the presence of moisture) to cause peeling.

The surfaces to be painted should be dry and warm, and the painted material should be protected from the weather, from extreme cold, and from the direct action of the sun until the paint is well dried. The plant which has no well equipped paint shop protected from the weather, is not prepared to do good shop painting. The quality of the work will vary with the weather conditions and there can be no uniformity in the results. It may be urged that the same objection applies to painting in the field. But the field painting is done during the most favorable seasons, and it is under the supervision of the company's own foreman.

It is the usual thing to find the paint applied in the shops by men who are unskilled in the work, and the foreman, very probably, is a man without the training necessary to handle the work properly. The shop manager seldom criticizes the quality of the work. The inspector will not bother the painters if they keep away from the steel until he has completed the inspection of the shop work. Accordingly, scant consideration is given to the condition of the surfaces to be painted, atmospheric conditions are disregarded, and the paint is manipulated with thinners and driers in order to cover the most surface in the least time.

A loading gang approaches freshly painted steel very gingerly, as such material has a habit of slipping off the hooks, racing along the skids, and skewing out of adjustment in loading. The simplest way to dispose of this difficulty would be to wait till the paint is dry, but this is not always possible. The shop is usually under instructions to ship as fast as the material is ready; or the paint shop may be congested with accumulating material. If the painting is done in a roomy yard, the material can be left where it is painted until it is to be loaded; but this brings us back to the objection to painting outdoors.

To correct the questionable practices at the shop, practical methods will be worked out when the railways and the inspection companies coöperate with the shop managers to bring this neglected part of the maintenance schedule up to the standard of the construction work. But the initiative must be taken by the railways, and when proper shop painting is one of the requirements the shops will meet it in a practical way.

The railways should supply the paint direct to the shop, ready to apply. This would do away with the incentive to slight the quality or the quantity; and it would leave no opportunity for the painters to manipulate the paint with thinners and driers, in order to make better time. The painting should be under the direction of a master painter, who should report directly to the proper official of the engineering department and be responsible for results in all the work coming under his direction. He would make it his business to know what was being done at the shops; and (working directly with the engineer) would be able to bring the necessary pressure to bear on shop managers to correct abuses he might find. This would be done through the agency of the shop inspectors.

The procedure would be simple. Give the shop inspector explicit and thorough instructions as to how this part of the work is to be executed. Have it plainly understood that this work will be passed upon in the field by men competent to decide and report whether the work at the shop was up to the requirements. Hold the inspectors responsible for any defective work that gets through. We should then find inspectors giving the same attention to the painting that they now give to the machine work. They would require surfaces to be clean and dry. They would not permit painting under unfavorable weather conditions. They would insist on competent and trustworthy foremen on the painting, as on the machine work.

The shop manager, finding that this work must be up to a certain standard before it will be accepted, would place the right kind of a foreman in charge of the work and give him competent workmen. With the right kind of men in the paint shop there would be less annoyance from obliterated shipping marks, and other troubles originating with incompetent workmen would disappear.

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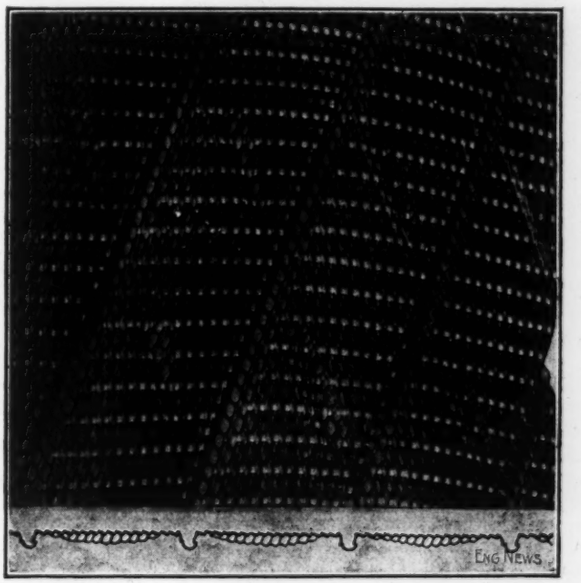
Metal Lath with Integral Furring Strips

The use of metal lath in building construction has increased very rapidly in recent years, but in connection with this it has been necessary to use a metal furring strip over the wood supports in order to secure a perfect key or bond of the plaster at these points. This led to the development of metal lath having the furring strips as an integral part of the lath, and in the first designs these were V-shaped ribs of solid metal left in the expanded metal sheet. This construction had the disadvantage that the ribs would be plastered on one side only,



METAL LATH, WITH RIBS FORMING INTEGRAL FURRING STRIPS

except where back plastering could be done. In a recent development the ribs have the same mesh as the rest of the sheet, so that they become filled with the plaster. The ribs are ½ in. thick and 12 in. apart, running diagonally across the sheet at the same angle as that of the mesh. The size of the sheet is 22x96 in., and the ribs are so formed that those of adjacent sheets will mesh and automatically regulate the amount of lap. The ribs form stiffeners, and it is stated that in building solid partitions it was found that this particular kind of lath could be used successfully with supporting channels spaced 32 in. c. to c. The plasterer could apply the mortar as easily as with the ordinary spacing of 12 or 16 in. for the sup-

ports, while in back plastering the decreased number of supports was a great advantage. For ceiling work with supports spaced 12 in. apart there was no trouble from sagging when applying the plaster. This new form of expanded-metal lath is being introduced by the Northwestern Expanded Metal Co., of Chicago, and has been given the trade name of "Kno-Fur."

While metal lath is a distinctly modern article in building construction, it actually dates back to 1839, when a patent was granted for such lath consisting of punched or perforated metal sheets. This style of lath, and also metal strips in place of wood strips, was used to a limited extent, but the development of metal lath as a commercial product followed the invention of expanded-metal in 1885.

Performance and Power Consumption of a 2½-cu.yd. Electric Shovel

By C. E. Hogle.*

The U. S. Reclamation Service is now engaged upon the construction of a dam across the Carson River at Lahontan, Nev. for the purpose of impounding water for use on the Truckee-Carson Irrigation Project.

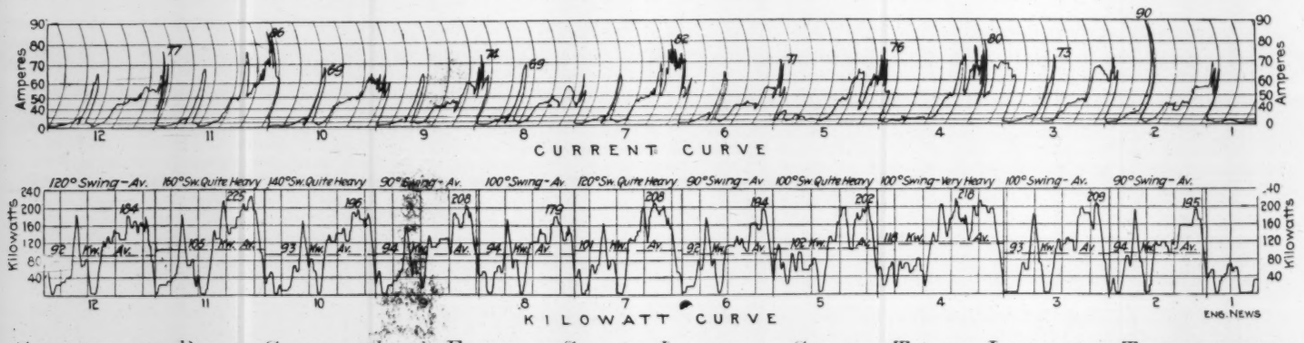
On account of the magnitude of this work and the high price of fuel, an hydro-electric plant of 1250-kv.-a. capacity has been installed just below the dam site. This plant is supplied with water from the existing canal which diverts water from the Truckee River and discharges it into the Carson River. It supplies practically all power for the construction of the dam as well as for all of the excavating machinery.

As the larger portion of the dam is gravel fill, an electric shovel (Bucyrus) with a 2½-cu.yd. dipper was purchased for excavating the gravel and an electric dragline excavator for stripping the gravel pit of the upper layer of sand and silt.

The construction of the electric shovel is practically the same as a steam shovel, except that the power is supplied by electric motors. The car body and house are mounted on M.C.B. standard trucks, the driving axles of which are supplied with split propelling sprockets. In the rear end of the house and directly behind the switchboard are located the three 90-kv.a., single-phase transformers which step down the line voltage from 2300 to 440, for which voltage the motors are wound. The primary side of the transformers on the shovel was connected to the 2300-volt distributing system by about 700 ft. of triple conductor 2300-volt flexible cable, armored with D-shape steel tape. This cable was laid on the ground and dragged along as the shovel moved up, thus allowing the shovel to move some 700 ft. without changing the taps on the 2300-volt line. This triple conductor armored cable is used largely by the Reclamation Service, for both 2300-volt and 440-volt work, and has given most excellent service. It is dragged around over rocks, through mud and water, and requires little protection. It is absolutely safe and is perfectly weatherproof.

When power is available at 15,000, 20,000 or 30,000 volts, this scheme could be used very nicely, by mounting high-tension outdoor-type step-down transformers and switching equipment on a sled or truck, and connecting the secondary side of these portable transformers to the shovel transformers by means of this 2300-volt armored cable.

The hoisting machinery is geared to a 115-hp. (intermittent rating) 440-volt, three-phase, 60-cycle, variable-speed induction motor, having a full-load speed of 680 r.p.m., the gear ratio from motor to drum being approximately 15 to 1. The propelling of the car is also accomplished with the hoist motor.



Current and Power Curves for an Electric Shovel Loading a Six-car Train; Lahontan Tests of the U. S. Reclamation Service

The swinging machinery is geared to a 50-hp. (intermittent rating) 440-volt, three-phase, 60-cycle, variable-speed induction motor, having a full-load speed of 680 r.p.m., the gear ratio from motor to drum being approximately 40 to 1.

The thrust motor, which is attached to the boom, is a 50-hp. (intermittent rating) 440-volt, three-phase, 60-cycle, enclosed-type, variable-speed induction motor, having a full-load speed of 680 r.p.m. This motor is geared to the shipper shaft through an intermediate shaft, the total gear ratio being approximately 10 to 1. On this intermediate shaft there is mounted an air-operated friction clutch. In addition, the intermediate shaft is also provided with a brake, operated by an air cylinder. The controlling air valve for this cylinder is connected to the motor-controller drum in such a manner that when the controller handle is on the off position the brake is set, and *vice versa*. This arrangement makes it possible to hold the dipper handle in any position with the current off the motor.

There is also a 2-hp., 440-volt, three-phase, 60-cycle, 1700-r.p.m. constant-speed induction mitor, direct-con-

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ELECTRIC SHOVEL TEST U. S. RECLAMATION SERVICE; TRUCKEE-CARSON PROJECT

Lahontan, Nevada, Oct. 14, 1912.

No. train	No. cycles	Cubic yards	Time in minutes required to load trains	Cycles per minute	Maximum peak per train Amperes at 2300 v.	Maximum peak per train kilowatts	Highest average kws. per cycle	Power consumed loading trains kw.hr.
9	12	24	4.08	2.94	88	226	112	6.22
10	12	24	4.57	2.62	97	259	132	7.68
11	12	24	4.75	2.52	87	236	120	6.75
12	12	24	4.00	3.00	90	225	118	6.40
13	11	22	4.00	2.75	99	252	102	7.12
14	12	24	4.50	2.67	90	238	126	6.15
Totals and averages	71	142	25.90	2.75	..	...	...	6.72

Total time elapsed from start of train No. 9 to end of train No. 14.....45.5 min.
Total time of loading trains.....25.9 min.
Total time of delays, moving up, waiting for cars, etc.....19.6 min.
Digging and loading period is 57% of total time.
Delays, moving up, etc. is 43% of total time.
On the above basis the amount of gravel excavated per 8-hr. day is 1500 cu.yd. of loose gravel.
Total power consumed by six trains is 42.96 kw.-hr. or, 7.16 kw.-hr. per train.
Total number of trains per 8-hr. day = 63.3.
Power consumed by shovel per 8 hour day = 453 kw.-hr.
Power consumed per cu.yd. of loose gravel = 0.302 kw.-hr.

nected to an air compressor which furnishes air to the friction brake on the hoisting drum, the emergency brake on the swing motor and the air-operated friction clutch and brake on the intermediate shaft.

The control of the hoist and swing motors is accomplished by means of master controllers, circuit breakers, solenoid-operated switches, jamming relays, current relays, and acceleration switches, so connected and interconnected that the operation of the motors is within the control of the operator so long as he does not try to operate the master controllers too quickly. Should this latter occur, or should the motors become stalled, the operation then becomes automatic and the switches are operated in the proper sequence by the current-limit devices. The thrust motor is operated by a reversible drum controller similar to the street-railway type, which is mounted on a platform attached to the boom. In addition to the acceleration resistance in the rotor winding of this motor, there is also a fixed resistance in this circuit which gives the motor drooping-curve characteristics and protects it from injury in case it becomes stalled.

The levers for operating the master controllers on the hoisting and swinging motors are very similar to, and are located in practically the same position as the operating levers on steam shovels. It has been observed that steam-shovel men, with a very little instruction, become excellent operators of these electric shovels.

In order to get some definite data regarding the performance and power consumption of this shovel, a test was made at Lahontan, Nev., on the morning of Oct. 14, 1912. A polyphase recording watthour meter, a polyphase curve-tracing wattmeter, a curve-tracing ammeter and a voltmeter were installed in the 2300-volt circuit supplying the shovel. The speed of the paper in the curve-tracing ammeter was 10¾ in. per minute, while the speed of the paper in the curve-tracing wattmeter was 11 in. per minute. The different operations of th eshovel are noted by a separate observer, who signaled to the instrument observers and also timed the different operations with a stop-watch.

The shovel was working in a gravel bank 10 to 12 ft. deep, and the clear lift of the dipper was 16 ft. The conditions of the work were not favorable to making a test for determining the maximum excavating capacity of the shovel. Only two six-car trains could be spared for the test, and no attempt was made to adjust the train length to the material to be excavated. The shovel has, however, been operated at very nearly four cycles per minute.

The tests lasted throughout six trains of six cars each and current and wattmeter curves were taken throughout the whole time covered by these six trains, thus giving a complete record of every operation. Only the curves for train No. 12 are shown in the accompanying figures. During the test of train No. 12 the voltage varied between 2360 and 1960.

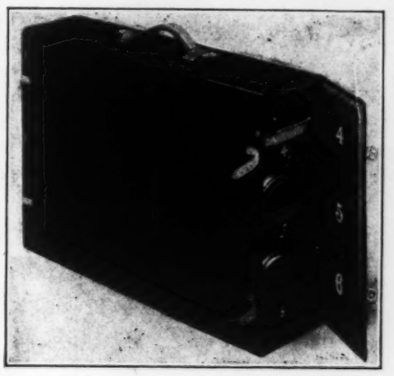
The data derived from these tests are grouped in the accompanying table.

A Nonfreezing Carrier for Dynamite

Dynamite in cold weather is troublesome and dangerous, as it freezes at about 40° F., and will not explode when frozen. It is, therefore, necessary to keep the dynamite magazines warm and to thaw any cartridges which become chilled. There are numerous designs of safely heated storage houses for explosives, and various devices for thawing dynamite; but in severe weather dynamite may be frozen between the time it is taken from the magazine and the time when it is used.

The use of frozen or partly frozen dynamite is exceedingly dangerous because a frozen cartridge or portion of a cartridge may remain unexploded when the rest of the charge is set off and may afterward explode when struck by a workman's pick or a drill or steam shovel.

A nonfreezing carrier for dynamite cartridges between the magazine and the place of use, made on the principle of the well known "Thermos" bottle, is now being introduced. The carrier is shown in the accompanying cut.



NONFREEZING CARRIER FOR DYNAMITE
(W. O. Taylor, Columbus, Ohio, inventor.)

When dynamite is placed inside of the bottles or "tubes," and the corks are firmly inserted in the ends, the dynamite will remain unfrozen within the carrier for at least 12 hours, even when the carriers is exposed during the entire period to a temperature of 12° to 25° below zero. The carrier is safe because no spark or flame can come in contact with the explosive while contained in the carrier. In a test at a quarry at Fairmount, Ill., the carrier was exposed for 18 hours to a temperature of 15° to 20° below zero, and the dynamite contained in it was then found to be unfrozen and ready for use.

Preliminary to charging, the carrier is placed in a room where the temperature is 65° F. or higher, and the corks are withdrawn from the tubes for at least five min-

utes. The dynamite is then placed in the tubes before the carrier is exposed to any lower temperature. After the corks are inserted in the tubes, the carrier may be taken on the work and the explosive will remain unfrozen for at least 12 hours, as noted. After the carrier is charged, the corks must remain in the tubes until the dynamite is required for use.

If it is desired at any time to use only a part of the dynamite contained in one tube, the cork is removed and the amount desired is taken out; the cork is immediately replaced, and the dynamite remaining in the tube will be ready for use later. If the dynamite remains in the tubes long enough to become frozen during very cold weather, it is only necessary to empty the tubes and allow the carrier to remain in a temperature of not less than 65°, with corks drawn, for five minutes, when it will be ready to recharge. But the dynamite must be thoroughly thawed before replacing in the carrier.

The largest size manufactured at present contains six tubes, three in each end of the carrier, as shown in the cut. Each tube will hold seven dynamite cartridges 1¼ in. diameter and 8 in. long. This carrier is 26½ in. long, 19 in. high and 7 in. wide, weighing 30 lb., exclusive of the dynamite.

This device was invented by W. O. Taylor, Vice-President of the Casparis Stone Co., of Columbus, Ohio, as a result of experience in the operation of this company's quarries. It is being introduced by the Dynamite Temperature Carrier Co., 200 Fifth Ave., New York, N. Y., and for information we are indebted to Geo. E. Hunter, Vice-President of this latter company.

❋

Examination Questions in Electrical Engineering

The following questions were given in an examination for the position of teacher of electrical engineering in the Evening High Schools of New York City, held on Jan. 2, 1913, at the headquarters of the Department of Education, 500 Park Ave., New York City. These questions were written from memory immediately after leaving the examination and, while not identical in wording with the original questions, they are so in meaning. The time allowed for the examination was four hours. The value of each question is indicated in parentheses following the question:

1. Describe the construction of the Clark cell and tell how it would be used in calibrating a voltmeter with a 150-volt scale. (10)
2. Describe the method of determining insulation resistance by direct deflection. What is a good value for the insulation resistance of an underground cable? (10)
3. The terminal voltage of a shunt generator is lower at full load than at no load. Explain all the factors which combine to produce this effect. (8)
4. Explain the principle of the Edison three-wire distributing system and tell what advantages it has over the two-wire system. Show how to operate a three-wire system from a regular two-wire generator. (10)
5. (a) What is the action of the equalizer in connection with the operation of compound-wound generators in parallel? (6)
   (b) Explain why the speed of a shunt motor is lower at full load than at no load. (4)
6. Explain the structural features of two different types of three-phase motors and tell to what uses each type is best adapted. (10)
7. Show why closing the primary circuit of a transformer does not short-circuit the generator. (10)
8. Show how to operate a two-phase motor from a three-phase line. Find the amperes per phase in a three-phase commercial motor of 20 hp., 500 volts, 80% power factor. (12)
9. Explain how to proceed to connect two three-phase generators in parallel. What action would tend to throw them out of synchronism and how would this be prevented? (10)
10. Explain the method of phase splitting devised by Tesla for making single-phase motors self-starting. (10)

Proportioning the Shell Plating of Tanks

Under the heading, "A New Point in Tank Design," J. T. Maguire, in ENGINEERING NEWS of Dec. 19, 1912, made a suggestion for saving metal in the design of tanks, standpipes, etc. He argued that the vertical joint in one ring is strengthened by the adjoining unspliced metal of the rings immediately above and below, and that for this reason a ring whose joint has 70% efficiency should be proportioned as though it had an 85% joint (the mean of 100% and 70%). Some comment on this subject follows.

H. W. Alrich, 4 Irving Place, New York, says:

> Permit me to commend your comment, and to add a little of my own. If the point that Mr. Maguire undertakes to discuss is new to him, one must believe that he is delving for the first time into the principles of steel-tank construction. As a matter of fact, the relation of the rivets in the horizontal seams to adjacent vertical joints in the several courses of plating was understood in the days of 70 years ago, when large tanks were built of segmental cast-iron plates bolted together. It is also a fact that in the design of very large steel tanks, such as are required for gas holders, the rivets in the horizontal seams are considered in their proper relation to the splices of the vertical joints.
>
> It is difficult to believe that anyone having such visions of the economy to be effected by designing a tank as Mr. Maguire suggests was ever connected with the construction of steel tanks of any considerable size, or ever had the opportunity to observe the elastic behavior of such a tank under hydrostatic pressure. In a paper read before the American Gas Institute in 1910, on tank construction, the writer analyzed (pp. 33 to 35) the elastic deformation which occurs in large tanks. Fig. 9, on p. 34 of that paper, was developed from theory, and also demonstrated by observations to correctly represent the behavior of a very large steel tank under hydrostatic pressure.

The illustration in question shows the shell expansion to be restrained at the top by the circular stiffening girder and at the bottom by the attachment to the tank floor, and to have maximum value at some point in the lower half of the tank.

P. L. Reed, Washington, D. C., supports Mr. Maguire's argument, and remarks:

> The analysis does not undertake to show where initial failure takes place, but does imply that the tank will not fail by the failure of one ring alone, which seems justified by experience. It simply attempts to prove that continuous rings on either side of a spliced ring can take such a portion of the normal stress in the latter, by means of shear through the horizontal riveted joints, as to give a uniform factor of safety for the combined section composed of alternate continuous and spliced plates.
>
> There is nothing intrinsically absurd in this theory, even when carried to the extreme of omitting all vertical rivets in alternate rings and (after substituting solder for watertightness) assuming that the tank will resist half the full load of water as is suggested in your comment; nor for that matter in substituting solder for all vertical riveting, though Mr. Maguire makes no such claim.

Mr. Maguire also writes to further support his theory. Referring to our comment (see issue of Dec. 19, p. 1153, 3d column), he considers the last paragraph of that comment to be a strong argument in favor of his theory, i.e., if the circumferential elongation of the two adjoining rings is the same for the solid metal of one and the riveted seam of the other, the former must be carrying some of the other ring's stress at that point:

> If we assume a joint-efficiency of 70% (see Fig. 1), and base the design of each individual strake on this assumption, we realize that the metal between rivet holes in vertical joints is stressed to 100% of the allowable stress, and the elongation of this metal corresponds with the stress. In other words the distance x on the plate A is considerably

greater [?] than the same distance x on the plates immediately above and below plate A. But if any tendency toward undue elongation in plate A is overcome by the transference of stress to the adjoining plates, through the rivets in the longitudinal seams, then the strength of the combination is the average of the alternate plates.

The failure of tanks by individual strakes instead of as a whole unit might be accounted for by the improper spacing of rivets in longitudinal seams (developing abnormal stresses), or a number of other reasons, all outside of the present discussion.

It is not consistent with reason, in the opinion of the writer, to imagine that the tank would be equally strong with vertical joints immediately over one another as it would be with staggered joints.

As regards the ability of a tank to resist a pressure of

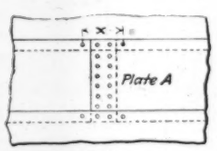


FIG. 1

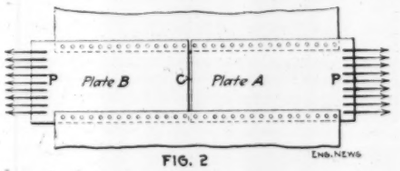


FIG. 2

fluid due to being half filled, with every alternate joint of zero efficiency, but watertight, the writer firmly believes that a tank properly designed as far as rivet-spacing and similar details is concerned would have this required strength.

In proof of his views, Mr. Maguire gives the following further considerations, illustrated by Fig. 2, which represents the tank surface developed into a plane. The plates *A* and *B* may have no connection along *C*, yet the tension *P*, due to the pressure in the tank, could be of considerable amount without causing failure, the tension being transferred from *A* to *B* by way of the longitudinal riveting to the adjoining plates, which is obvious. If this is true for a joint *C* of zero efficiency, it would apply still more in the actual case, where *C* has, say, 70% efficiency.

This illustration seems to ignore the fact that the water pressure is normal to the plate, and will bulge out the edges at *C*. We suggest that study of Fig. 2 be amplified by considering the water pressure normal to the plate, as is actually is, in addition to retaining the tensile forces *P* shown in the sketch.

The entire case is worth having the reader's careful study. It is an interesting case of distinguishing between designing to suit the actual distribution of stresses and calculating the stresses to go where the design provides metal to take them.

NOTES

An Early Fireproof Shutter—Outside sliding sash were used to some extent in buildings of two or three centuries ago, according to recent correspondence in "Zentralblatt der Bauverwaltung." Projecting stone sill and lintel courses, extending one side of the window a distance equal to the width of the opening, and grooved in the facing surfaces to take the sash, have been found in Scotch buildings. In a German castle ruin such grooves have also been found, and still in place within them stone shutter slabs. It is thought that one reason for using these stone shutters was the desire to protect against entrance of firebrands thrown by an attacking enemy.

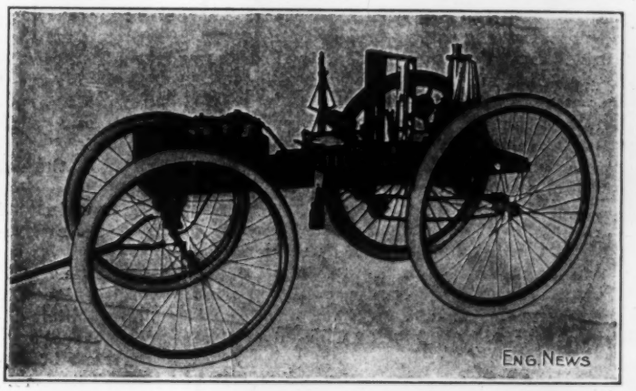
Another Tank Question—The discussion on tank design in this issue raises two further questions:

1. Should the doubling of metal at the horizontal seams be credited to the shell strength?
2. Is the plate-thickness of a given ring to be proportioned for the hydrostatic head at the bottom of that ring or at midheight of the ring?

We regard the two questions as being connected. The lower part of a ring is strengthened by the excess metal at the lap and also by the excess strength in the upper part of the ring next below. The textbooks on tank design usually either dodge the question of designing the shell for middle or bottom of ring, or they recommend designing for the bottom. In practice, shell plates are sometimes designed for the pressure at middle of ring.

A Mechanical Surveyor—An automatic level-man and profile draftsman has been invented and patented by M. J. Dykeman. It is an instrument which only needs to be hauled over the route whose profile is wanted, and not only turns out a profile drawn to scale and stationed, but also deposits at suitable intervals along the line properly-marked stakes. This mechanical surveyor is shown by the halftone below. It is made by the Dykeman Surveyor Co., of Detroit, Mich.

The working parts of the instrument are mounted on a light road-vehicle body, fitted with pneumatic-tired wheels for smooth riding. A drive from the rear axle moves a strip of profile-paper over two drums, and also moves a pencil, whose direction of travel is transverse to the motion of the paper. When the vehicle is drawn along, the strip of paper moves horizontally with a speed proportional to the velocity of the vehicle, and the pencil moves vertically over the paper. The rate of movement of the pencil is controlled by a pendulum, which by means of a cam affects the train of friction disks driving the pencil; the result is that the pencil moves vertically at a speed proportional to the vertical ascent or descent of the vehicle, i.e., proportional to the product of vehicle speed and roadway gradient. By the same means, the



A NEW SURVEYING INSTRUMENT FOR MAKING PROFILES AND SETTING STAKES AUTOMATICALLY

speed of travel of the paper is so controlled as to represent at all times the horizontal component of the vehicle's motion. A station mark is automatically stamped on the paper at suitable intervals.

A stake-setting device is placed directly behind the profile recorder and, like it, is driven by a chain and sprocket connection to the rear axle By means of a 60-lb. spring and a trigger, controlled by the station marker, a small steel stake is projected into the ground simultaneously with the marking of the station on the profile sheet.

A Self-locking Car Seal.—A new car seal requiring no tools to apply it is manufactured by the International Seal & Lock Co. of Hastings, Mich. It is being used to some extent by railroads and by large shippers, and has also been applied by insurance companies to the sealing of sprinkler valves. The seal consists of a flat ribbon of sheet iron at one end of which there is fixed a small hollow button containing a spring-lock mechanism. By slipping the free end of the sealing strip into a slit in this button the lock is sprung, engaging a hole in the end of the strip. When the seal is once applied it cannot be removed without mutilating it.

For large users these seals are put up in 5000 lots and cost $3 per thousand, but they are also sold to smaller users in 1000 and 2000 lots at $4 per thousand. They are furnished embossed with any combination of 16 or 17 letters desired, numbered consecutively, and strung on wire, 100 in a bunch.

Long-time Tests of cement briquettes are reported by Prof. Isami Hiroi, of the Tokyo Imperial University, Japan, in the "Proceedings of the American Society of Civil Engineers," December, 1912, page 1717 (a paper to be read Feb. 19, 1913). The briquettes tested were made about 15 years ago, in sufficient quantity so that a record of 50-year performance could be kept. The results now reported cover a period of 14 years, which, so far as we know, is the longest period over which such tests have been made.

The first set of tests was made on 1:3 sand-cement briquettes, with a coarse beach sand in one group and standard sand somewhat finer in the other. One-third of the briquettes

were stored for the entire period of 14 years in open air in a shed; one-third in fresh water which was renewed every week, and one-third in sea water also renewed once every week, Each briquette was made in the standard form and kept in a moist closet for 24 hours before being put in its final medium. Five briquettes were tested for each type, and the results given are the averages of the five. The strengths with coarse and standard sand were found to be so nearly alike that the mean results were taken in plotting the curves, which are given in the paper. The strength attained by the use of finer sand came considerably lower. The paper states:

It will be seen, as might have been anticipated, that the mortar attains the greatest strength in air and the least in sea water, the mean comparative ratio of strength attained being nearly as follows:

Air	1.00
Fresh water	0.56
Sea water	0.45

The curves of strength thus traced are approximately hyperbolic and are expressed in equations in the original paper, plotting between time and strength. These mortars showed a fairly uniform increase in strength and attained their greatest strength in about six to ten years, beyond which, although they still continue (through occasional ups and downs) to increase in strength, the rate of increase is inconsiderable.

A second set of tests was made on neat-cement briquettes, and the results are entirely different. Those kept in sea water attained their greatest strength in about two to ten months, after which they rapidly declined, in some cases completely losing their strength in four or five years. The neat-cement briquettes in fresh water and in air did not show so decided a deterioration, but reached their maximum at about four years, after which they commenced to decline in strength. These figures show the decided superiority in the long run of the use of a 1:3 sand mortar over neat cement.

A similar set of experiments using hydraulic lime instead of cement in the sea-water tests showed a complete disintegration of the briquettes in about a year.

In a third series of tests briquettes were kept immersed in fresh water for two months before they were finally placed in sea water, in partial reproduction of the conditions which obtain with concrete blocks used in sea water. In these tests the increase of strength is not as rapid as in the case of briquettes immersed directly in sea water, but the rise is more steady and continues much longer. In these tests also the neat-cement briquettes reached their mixmum in about two years, after which the rate of decline of strength commenced.

Blueprint Rack—Racks for blueprints of current work, of the general type illustrated by the view herewith, are coming into use in many drafting rooms and engineering offices. They keep the prints flat, and make a large number of drawings accessible almost instantly. The one shown is used by J. L. Sheppard, Jr., Construction Superintendent at Newark, Ohio, for the New England Engineering Co. The rack is used for subdividing a large set of blueprints used on a power-house contract. Mr. Sheppard says:

The prints bearing on the same part of the work are assembled in one holder, thus obviating the necessity of having numerous prints in the field when information is desired from only one or more. A complete set of prints is assembled in one holder for office use. The holders are made preferably from some light wood, such as white pine or cedar, with a cross-section of 1¼ x 1¼ in., the blueprints being clamped between the two strips with ⅜ x 1-in. machine screws with wing nuts.

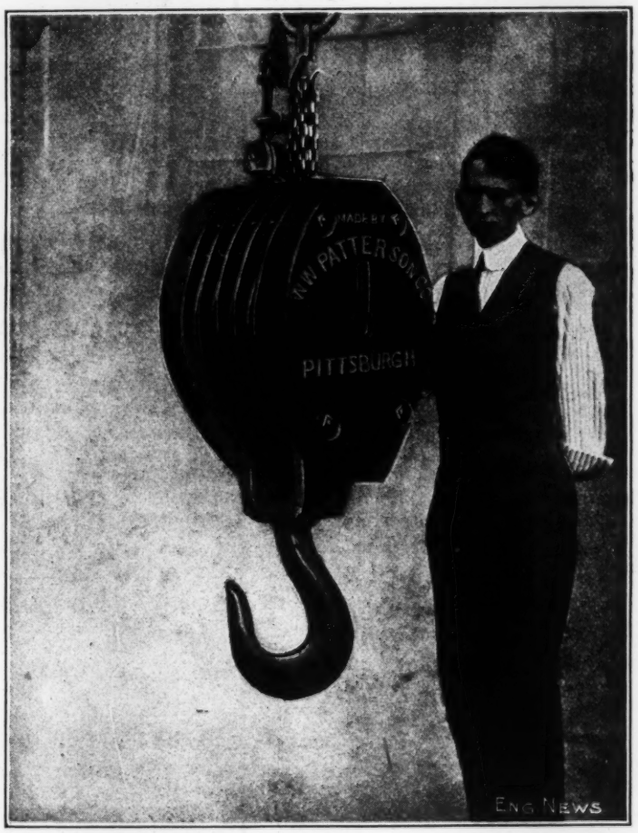
The Construction of Concrete Tennis Courts is described as follows, in the "Universal Bulletin," for January, 1913:

A court near Cadillac, Mich., is about 46x98 ft. in size, giving a margin outside the court limits of 5 ft. on all sides. The court has a total thickness of 5 in. and consists of a 4-in. base of 1:2½:5 concrete, a 1-in. top of 1:2 cement mortar, and a sand foundation, tiled along two sides for drainage.

In constructing the court the general principles governing first-class sidewalk construction were followed. A joint was placed at each court and service line, and across the court at the net line. This divided the court into a number of large slabs, each of which was reinforced with wire mesh. The play lines were formed by placing 1½-in. wooden strips between the slabs at the time of construction, the strips being afterward removed and the space filled with white cement mortar, thus marking the lines permanently. The top coat of the court proper was colored green to reduce the reflection of light.

Several years ago the Duluth Boat Club, Duluth, Minn., placed concrete over three of its tennis courts on a filled-in dock. The courts were formerly surfaced with clay, but concrete replaced this because the clay had to be renewed each season. The courts were laid on a fill 4 ft. above the water level of the surrounding harbor. The combined width of the three courts is 150 ft. and the length 100 ft. For convenience in laying, the concrete was put down in strips about 10 ft. wide and 150 ft. long. These strips were divided into three sections, each equal to the width of a court, or 50 ft. Expansion joints extending the full length of the courts were thus provided for. The total thickness of the slab was 4 in., consisting of a 3¼-concrete base and a ¾-in. top or wearing surface of cement mortar.

A Heavy-service Weight Block.—Three interesting features appear in the new type of weight block manufactured by the W. W. Patterson Co., of Pittsburgh, Pa. The construction of



A Quadruple Weight Block, Arranged for Quick Replacing of Sheaves

the block is such that a sheave can be replaced at any time without removing the weight castings. The bolt heads and the sheave pin cotter being countersunk, there is nothing on the block that can foul on the side of a building or elsewhere that it may be used. Finally the new becket attachment provided allows of the quick removal of the twist or "wind" in the becket line.

The block shown in the cut has a double swivel hook, forged from 3¾ in. round stock and safe for a working load of 25 tons. The weight of the block complete is 1030 lbs.

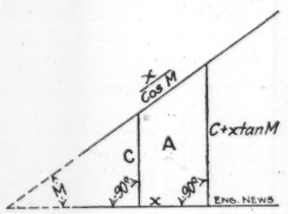
Food Supplies for Construction Camps.—A. H. Bromley in a letter to the "Enginering and Mining Journal" gives the following data of interest to contractors and engineers who have to maintain construction camps in the wilds:

The following list was compiled by a Canadian Pacific Ry. engineer from several years' store sheets, and represents the daily ration per man, in construction camps. The bacon and flour may be a little high, but much depends upon work being done, working temperature and cook's ability. If tinned meat be taken, the bacon can be reduced. Beside the supplies in the list, a little lard was used in the cooking, for which no allowance is made. The total of the above ration is 4.32 lb. Other supplies on a per diem basis were: Soap, 0.05 lb.; candles, 0.01 lb.

DAILY RATION

	lb.		lb.
Flour	1.25	Salt	0.10
Bacon and ham	1.40	Mustard and pepper	0.01
Beans	0.47	Currants	0.03
Dried fruit	0.20	Raisins	0.01
Sugar	0.40	Oatmeal	0.15
Tea	0.04	Rice	0.05
Coffee	0.08	Tomatoes or vegetables	0.04
Baking powder	0.06	Syrup	0.03

Lots Between Non-parallel Lines—It is often necessary to lay out property in equal-sized lots (or more generally in lots of specified area, between front and rear lines not parallel with each other. B. S. Dinsmore, New Kensington, Penn., who has often had this problem to handle, worked out the necessary formulas for it as follows: In the sketch the lines making an angle with each other are the front and rear lines; between them are to be run lines at right angles to the front line, inclosing lots of specified areas.



Let A represent the desired area, M the angle between the lines, x the base (unknown), C the known altitude, and C + x tan M the other altitude (unknown). The area is

$$A = \frac{x\,(2\,C + x \tan M)}{2}$$

Solving this quadratic equation gives,

$$x = \sqrt{\frac{2\,A}{\tan M} + \frac{C^2}{\tan^2 M}} - \frac{C}{\tan M}$$

For the first lot at the corner of the triangle the formula may be worked out separately or it may be deduced from the above by putting C = 0, in either case giving the result

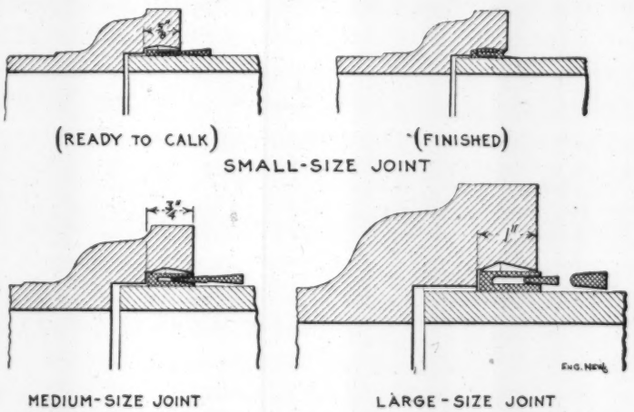
$$x = \sqrt{\frac{2\,A}{\tan}}$$

When working toward the corner instead of away from it, i.e., when the unknown altitude is less than the known altitude, certain signs in the formula will be changed, the result being,

$$x = \frac{C}{\tan M} - \sqrt{\frac{C^2}{\tan^2 M} - \frac{2\,A}{\tan M}}$$

A New Lead Pipe-Joint—The various troubles in making the standard poured lead joint in cast-iron pipe lines are overcome by a wedged lead joint brought out recently by a Frenchman, L. Billé, of 37 Grande Rue, Nogent-sur-Marne, France. The sketch herewith, showing three forms of the joint as applied to bell-and-spigot pipe, illustrates its nature.

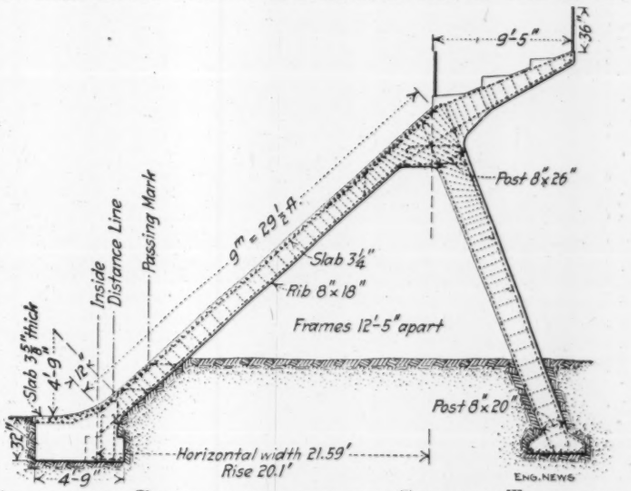
The lead wedge rings may, of course, be applied to sleeve joints on steel or cast-iron pipe as readily as to bell joints. The sketches explain themselves. The small-size type, having



BILLE'S PIPE JOINT. MADE WITH LEAD WEDGE-RINGS

a single wedge, is to be used for pipe 2 to 6 in. diameter; the medium-size type, with two-taper wedge, as recommended for bell joints of 7-in. to 22-in. pipe and for sleeve joints on pipe up to 48 in.; the large size, using two short wedges in series, is for bell-joint pipe above 22-in. diameter and for sleeve-joint pipe above 48-in. diameter. These joints have been tested to high pressures successfully. The city of Paris is soon to lay a water main with Billé joints, it is reported. The inventor claims a saving of 8% to 15% over poured lead joints.

Dimensions of a Cycling Oval—A bicycle-racing saucer-shaped track of reinforced concrete recently built near Zürich, Switzerland, has a length of one-third kilometer (1093.3 ft.), measured 12 in. from the inner edge and a width of 29½ ft. on the slope. The middle part of each side is straight for a length of 119 ft., the ends are circular with radius 86 ft., and the joining portions are transition curves varying in radius of inside edge from 455 ft. to 86 ft., for a length of 157 ft. The track is 201 ft. wide and 440 ft. long, inside of inner edge. The banking was computed on the basis of 30 mi. per hr. average and 55 mi. per hr. maximum speed, but a small banking is also carried along the stretches. To reduce the longitudinal slope of the outer parts in rising up to the banks at the turns, the inner line of the turns is depressed 3 ft. below the inner line of the stretches; a line 6 ft. from the inner edge of track is level throughout. The banking is 5.1 ft. on the stretches, and 20.1 ft. on the end curves, making the inclinations 18% and 90%, respectively. At the turns the track is widened by about 3 ft. inward from the inner edge, and here the slope curves down to horizontal, as may be seen in the



SECTION OF REINFORCED-CONCRETE CYCLING TRACK ON BANK

section sketch. A small part of the track rests directly on the ground; in this portion 7 in. of broken stone leveled off with 2-in. concrete serves as the foundation for a 3¼-in. reinforced-concrete slab, edged by 12x20-in. reinforced-concrete beams. The rest of the track (except the turns) is formed of a 3¼-in. slab on reinforced-concrete cross-frames set into the fill. The turns are of similar construction without fill, and carry seat banks on a cantilever projection at the upper side, as shown by sectional sketch. A 1-in. wearing surface of 1:3 cement mortar tops off the slab. A full description of the track is given in "Schweizerische Bauzeitung" of Dec. 7, 1912.

A Diagram for Area of Railway Culvert Openings

BY T. J. WRIGHT, JR.*

I am pleased to send you herewith a blueprint of a diagram for the graphical solution of the Wentworth formula for determining area of culvert opening required to carry run-off from any given area up to 1,000,000 acres. We have found that this saves considerable time and it may possibly be of interest to those of your readers who are working in districts where the formula is applicable.

The Wentworth formula† is in use by the Norfolk & Western Ry. on that part of the line lying between the

*Engineering Department, Piedmont & Northern Lines, Charlotte, N. C.

†The Wentworth formula: $a = d^{\frac{3}{4}}$, where a is the sectional area of the waterway, in square feet, and d is the drainage area, in acres. This formula was derived in connection with work on the Norfolk & Western Ry., and is especially fitted to the conditions in the southeastern states. In cases of less rainfall, or if the ground be quite flat, the author states that the two-thirds power of the drainage area is too great for the square feet of area needed in the waterway. In the observations of Mr. Wentworth, 60% of the resulting area may be taken as the lower limit.

slopes of the Blue Ridge and the Ohio River, and owing to the fact that its use has been limited to this section (or others of similar topography) no rainfall or run-off factors have been necessary. It is discussed by Mr. Churchill, Chief Engineer of the N. & W. Ry., and by Mr. Wentworth, on pp. 35 and 143 of Bulletin 108, American Railway Engineering Association. It is discussed also on p. 492 of Part 3, Vol. 12, of the 1911 *Proceedings* of the Association.

I recently figured openings required for five streams at points between Greenville and Spartanburg, S. C. I used the Wentworth formula and checked the results by assuming a run-off of 100 cu.ft. per sec. per sq.mi., with a mean velocity of the stream of 5 ft. per sec. These assumptions are warranted, I think, by the U. S. Geological Survey report on the Pacolet River flood of 1903. (Water Supply and Irrigation Paper No. 96.) The results were as given in the accompanying table. It has been my experience in general, that the formula gives reliable results in the hilly country of the Virginias and in the Piedmont district of the Carolinas. In every case, however, consideration must be given to local conditions.

TABLE OF COMPARATIVE COMPUTATIONS OF CULVERT OPENINGS

	Area drained		Opening required., sq.ft.	
	Sq.mi.	Acres	Wentworth Formula	Assumed Data
Fair Forest Creek	12	7,680	390	240
North Tiger River	47	30,080	960	940
Middle Tiger River	54	34,560	1050	1080
South Tiger River	74	47,360	1300	1480
Enoree River	59	37,760	1130	1180

Example of Use of Diagram—Find the area of culvert required to drain 440 acres. Enter the diagram at bottom at 4.4, and follow the vertical line to intersection with diagonal line marked 100-1000 acres (440 being between these limits). Thence follow the horizontal line to the border, which will be found to reach point 5.8. Since the result must lie between 21.5 and 100 sq.ft., the required area of culvert opening is 58 sq.ft. For 4400 acres, enter the diagram as before, but follow the vertical line to the diagonal line marked 1000-10,000 acres; thence follow the horizontal line, and the result is 269 sq.ft.

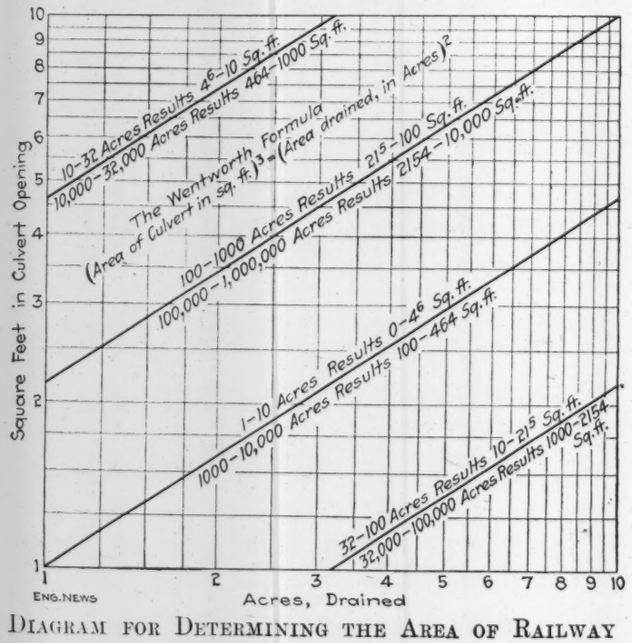

Square Feet in Culvert Opening
Acres, Drained
ENG.NEWS
10-32 Acres Results 46-10 Sq.ft.
10,000-32,000 Acres Results 464-1000 Sq.ft.
The Wentworth Formula
(Area of Culvert in sq.ft.)² = (Area drained, in Acres)²
100-1000 Acres Results 215-100 Sq.ft.
100,000-1,000,000 Acres Results 2154-10,000 Sq.ft.
1-10 Acres Results 0-46 Sq.ft.
1000-10,000 Acres Results 100-464 Sq.ft.
32-100 Acres Results 10-215 Sq.ft.
32,000-100,000 Acres Results 1000-2154 Sq.ft.

DIAGRAM FOR DETERMINING THE AREA OF RAILWAY CULVERTS
(Based on the Wentworth Formula)

Standard Sizes of Conduits for Electric Conductors

The use of steel-pipe conduits for the protection of all sorts of electric-service wires in building construction is greatly increasing. Practice is known to vary, from the use of smaller sizes than desirable for ease of drawing in, to the use of extravagantly large diameters. To establish a standard practice in the use of sizes neither over-economical nor extravagant, the National Electrical Contractors' Association has adopted tables and charts of sizes of conduit which it recommends for general use.

The tables show in condensed space all proper sizes from that for one No. 14 wire up to four 500,000 circ.-mil. and three 2,000,000-circ.-mil. conductors. There are also data for three-wire convertible systems, single-wire combinations, signal and telephone circuits. The charts show full-size cross-sections of conduit with the various conductors in place. The several charts are mounted on heavy board for hanging, and are sold by W. H. Morton, Secretary of the National Electrical Contractors' Association, 41 Martin Bldg., Utica, N. Y. We have reprinted in the accompanying table (copyrighted and used by permission) the association's data on ordinary and telephone systems.

STANDARD SIZE OF CONDUITS FOR THE INSTALLATION OF WIRES AND CABLES

(As adopted and recommended by the National Electrical Contractors' Association of the United States. Copyrighted and used by permission).

Conduit sizes based on the use of not more than three 90° elbows in runs taking up to and including No. 10 wires; and two elbows for wires larger than No. 10. Wire No. 8 and larger are stranded.

NUMBER OF WIRES IN SYSTEM

Size B. & S.	Cap'y Amps.	One wire in a conduit Size conduit,in. Int'l.	Ext'l.	Two wires in a conduit Size conduit,in. Int'l.	Ext'l.	Three wires in a conduit Size conduit,in. Int'l.	Ext'l.	Four wires in a conduit Size cond., in. Int'l.	Ext'l.
14	12	½	0.84	½	0.84	½	0.84	¾	1.05
12	17	½	0.84	¾	1.05	¾	1.05	¾	1.05
10	24	½	0.84	¾	1.05	¾	1.05	1	1.31
8	33	½	0.84	1	1.31	1	1.31	1	1.31
6	46	½	0.84	1	1.31	1¼	1.66	1¼	1.66
5	54	¾	1.05	1¼	1.66	1¼	1.66	1¼	1.66
4	65	¾	1.05	1¼	1.66	1¼	1.66	1½	1.9
3	76	¾	1.05	1¼	1.66	1¼	1.66	1½	1.9
2	90	¾	1.05	1¼	1.66	1½	1.9	1½	1.9
1	107	¾	1.05	1½	1.9	1½	1.9	2	2.37
0	127	1	1.31	1½	1.9	2	2.37	2	2.37
00	150	1	1.31	2	2.37	2	2.37	2½	2.87
000	177	1	1.31	2	2.37	2	2.37	2½	2.87
0000	210	1¼	1.66	2	2.37	2½	2.87	2½	2.87
Circ. mils.									
250,000	235	1¼	1.66	2½	2.87	2½	2.87	3	3.5
300,000	270	1¼	1.66	2½	2.87	2½	2.87	3	3.5
400,000	330	1¼	1.66	3	3.5	3	3.5	3½	4.0
500,000	390	1½	1.9	3	3.5	3	3.5	3½	4.0
600,000	450	1½	1.9	3	3.5	3½	4.0		
700,000	500	2	2.37	3½	4.0	3½	4.0		
800,000	550	2	2.37	3½	4.0	4	4.5		
900,000	600	2	2.37	3½	4.0	4	4.5		
1,000,000	650	2	2.37	4	4.5	4	4.5		
1,250,000	750	2½	2.87	4½	4.5	4½	5.0		
1,500,000	850	2½	2.87	4½	5.0	5	5.56		
1,750,000	950	3	3.5	5	5.56	5	5.56		
2,000,000	1050	3	3.5	5	5.56	6	6.62		
Duplex Wire:									
14	12	½	0.84	¾	1.05	1	1.31	1	1.31
12	17	½	0.84	¾	1.05	1	1.31	1¼	1.66
10	24	¾	1.05	1	1.31	1¼	1.66	1¼	1.66

Example—To ascertain the size of conduit for three No. 4-0 wire, follow down the wire column to No. 4-0 and then across to the section headed "Three wires in a conduit" and it will be seen that 2½ inch conduit is the size to use and that the external diameter is 2.87 inches.

TELEPHONE CIRCUITS

Note—The permissible wires of the telephone companies of various cities differ as to thickness of insulation, therefore the following tables give both light and heavy insulation and the headings give the trade names of the wires used.

Based on not more than two 90° elbows.

No. 20 braided and twisted pair, switchboard or desk instrument wire.

No. of pairs	Size conduit, in. Inter'l	Exter'l
5 pair	½	0.84
10 pair	¾	1.05
15 pair	1	1.31
25 pair	1¼	1.66
35 pair	1½	1.9
50 pair	2	2.37

No. 19 braided and twisted pair, standard $\frac{1}{32}$" insulation telephone wire.

No. of pairs	Size conduit, in. Inter'l	Exter'l
3 pair	½	0.84
6 pair	¾	1.05
10 pair	1	1.31
16 pair	1¼	1.66
25 pair	1½	1.9
35 pair	2	2.37

EDITORIALS

Proposed Amendments of the Patent Laws

It is extremely doubtful whether at the present short session of Congress, with an impending change in the political complexion of the government, any legislation will be enacted affecting the United States patent system. It is a fact, however, that numerous bills are pending before Congress and have been pushed more or less actively before the House Committee on Patents, which, if they were made law, would work serious injustice and harm to American inventors. On the other hand, there are many features in the present patent system and in the administration of the patent law which need revision, both in the interest of the public and in the interest of adequate encouragement to the development of new inventions.

The use of patents as a foundation for industrial combinations has provoked a great amount of public opposition. There is danger that this opposition may bring about sweeping alterations in the patent system which would greatly hamper engineering and industrial progress. Resolutions have been adopted by the governing board of the American Institute of Electrical Engineers and are pending before other engineering societies which propose that the whole matter of patent-law revision should be referred by Congress to a commission, "to be made up of unbiased, independent, non-partisan men of such national standing as will command the respect of the whole country. Such a commission would hold public hearings and make a thorough and careful study of the American patent situation and would make a report and recommendations to Congress for such changes, if any, as might appear to it expedient."

This is without doubt the sane and sensible way of dealing with this difficult question. If Congress enacts any legislation whatever on the patent situation at this session, it is to be hoped that it may take this form.

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A Low Record Death Rate for New York City

A total of 73,008 deaths in a single city in one year seems appalling until it is known that the city was New York, with a population sufficiently above the five million to bring the rate per 1000 down to the remarkably low figure of 14.11. There are possibilities, of course, that the population estimate is too high or that the death registration was incomplete, but there seems to be reasonable basis for confidence in both. This confidence is increased when it is noted that the total number of deaths in 1912 was 2418 less than in 1911, and much less than the average for the ten years 1902-11; that there were heavy reductions over the average for 1902-11, in all the communicable diseases, in mortality from diarrhœal diseases under five years of age, and in infant mortality; and that in the large non-communicable class the only increases in 1912, were in deaths from cancer, homicide and organic heart disease—the latter being offset by a decline in deaths from apoplexy and diseases of the arteries.

It is particularly gratifying to note that the typhoid-fever death rate for 1912 was 34% less than the average for the previous decade and that the infant-mortality rate for the year was only 105 per 1000 reported births, the lowest ever recorded.

Record death rates are also reported for Boston, Philadelphia, Washington, Toronto and the states of New York and Connecticut. After allowing for favorable weather conditions in 1912, a goodly part of this decline may still be credited to concerted human agencies.

In our issue of Nov. 10, 1910 (p. 516), we discussed "The Declining Death Rate and the Engineer." We were not able, of course, to say just what part the engineer had played in bringing the death rate of the registration area of the United States down to 15 per 1000 for the year 1909, and the rates for England and Wales to 14.5, and of London to 14 for the same year. But we could say with confidence that the engineer had played an important part in reducing typhoid fever and that there were further possibilities for him in the reduction of deaths from accident, and from various other causes, as well as in the reduction of the general death rate.

Finally, we may call attention to the fact that the low death rate of 1912 for New York city, has fallen under the administration of a health officer who is at least a near-engineer, Ernst J. Lederle, a sanitary chemist, long associated with health work in New York City, and once before during this decennial of falling death rates rates, health commissioner of New York.

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Concerning Railway Drawbridges

The interesting paper in this issue by C. E. Smith, on railway drawbridges over rivers having limited navigation, presents some facts which are worth further study. The principal one of these facts to which we wish to direct attention is that in the eyes of the law traffic by water has superior rights to traffic by land. Just why this should be is a little difficult to say. The probability is that since the water highway was in its natural state unhindered by any bridges crossing it, the law assumes that the users of the water highway have a perpetual right to its free and unhindered navigation. The law assumes apparently that this right is of the same nature as a property right and hence that it cannot be taken away or infringed by those who use the bridge across the stream no matter how numerous they may be or how large are the property interests involved.

This theory of the law, of course, harks back to the time when the water highways were the chief avenues of through traffic and when such crude bridges as crossed them were few in number and carried for the most part merely local traffic.

To say that this ancient theory of the law leads to gross absurdities is to put the case very mildly. It is for one thing a contradiction of that other principle of law, well recognized to be a sound guide in most matters—the principle of the greatest good to the greatest number.

If a man from Mars were to visit our planet he would be vastly surprised to see the entire traffic on a busy trunk-line railway brought to a standstill at a certain point in order to allow the opening of a drawbridge and the passage through it of some old scow loaded, perhaps, with manure or some similar cheap bulk freight. The scow may come along just at a time when the rush of suburban traffic is heaviest in the morning or evening hours. It makes no difference; ten thousand passengers must suffer delay rather than the scow owner.

At another city the man from Mars would find a bridge set at a height requiring all traffic across it—railway trains, street cars, loaded trucks, foot passengers—to climb up 10 or 20 ft. of extra height, necessitating steep grades on the approaches, rather than compel the owners of a few boats navigating beneath the bridge to so construct their craft as to be able to pass under it with less head room.

He would see, as narrated in the cases cited by Mr. Smith, a railway constructing a bridge across a stream on which boats pass up or down barely once in a week. But because the boat has a vested right and can mulct the railway for every obstruction that may be placed in the way of its free passige, the man from Mars would see boats coming past there every day on a chance that some obstruction to their passage as a result of the construction work might give them foundation for a damage claim against the railway company.

Perhaps it may seem like tilting at a windmill to propose disturbing a vested right of such long standing; but we believe the only reason why this vested right has endured so long is because the public has no appreciation of the fact that its maintenance is contrary to the public interest, and, in fact, results in an enormous public injury.

It is a fact that every drawbridge opening in a railway line costs the railway a large sum to construct and to maintain it. The draw span and its machinery must be, above all things, reliable; it may be opened for the passage of vessels only once a week or once a month, but its construction must be such that so far as human ingenuity and vigilance can contrive, the bridge will be absolutely certain to close and open when the necessity arises. All this costs money, not only in the original construction, but in maintenance and inspection and in attendance, for every drawbridge requires attendants and unless traffic on the stream which it crosses is confined to the daylight hours, there must be two or even three shifts of attendants to be on hand whenever necessity for opening the bridge may arise.

Again, every drawbridge is a potential cause of serious disaster. Some of the worst railway wrecks on record have been due to trains plunging into an open draw Every drawbridge should be provided with a thorough system of signaling and interlocking for the protection of the traveling public. This must all be inspected and maintained in perfect order at all times.

The public is oblivious to all this because it fancies that the burden which is involved rests upon the railway companies. The public forgets that the railway has in the long run to obtain the money for each and every expense that it incurs by collecting it from travelers and shippers. In the long run the cost of building and operating drawbridges, as well as the necessary risk involved in their use, must be borne by the public.

The case is, in fact, exactly the same as if the railways were owned by the government. Whenever the public awakens to the idea that in considering the relative rights of transportation by land and by water where the two routes conflict, the principle of the greatest good to the greatest number should govern and not the principle of vested rights—when that comes to be realized we shall see a change in our present laws governing drawbridge construction and operation.

We are not, of course, urging by any means that all drawbridges should be made fixed spans, or that railways over rivers or street bridges across them should be allowed to unreasonably obstruct the waterways beneath, even though the land traffic may be hundreds or thousands of times as great as the water traffic. What we do urge is that the law should be so modified that common sense and reason may take the place of the present principle of vested rights.

As a result of the recent agitation to revive inland navigation, there have been cases in the West where railway bridges across streams in which a boat had not run for years have been obliged to have parts temporarily removed because of the whim of some enthusiast who wanted to run a boat up a channel long since abandoned.

There are cases where a railway could well afford to carry on, free of charge, the entire transportation work done by a river steamboat rather than incur the expense of building and operating a drawspan.

There are other cases where a drawbridge opening originally made to accommodate a considerable water traffic, now accommodates so few vessels that restrictions as to the time of its opening would save delays to many thousands of passengers every year and a large amount of money to the railway company by reducing the hindrance to traffic movement.

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The Control of Banking over Industry

The proceedings of the so called Money Trust Investigating Committee of Congress have served to direct public attention recently to some very important problems in connection with finance, economics, industry and trade. It is not inappropriate, we believe, that some of these matters should be discussed in the columns of an engineering journal inasmuch as a very large proportion of our industrial and transportation enterprises are administered by engineers. In all construction work the financing is a preliminary stage, which must be passed through before the engineer can undertake his work. Upon the way in which this financing is done the character of the engineering work very largely depends.

More than this, the problem of public control by legislative process or executive action is not only dominant in connection with common carriers and all the so called public-utility corporations, but is being largely extended in connection with manufacturing enterprise of various sorts. And this public control has to be effected to a large extent through engineers.

One does not have to view the money-trust agitation with a prejudice excited by flaming headlines in sensa-

tional newspapers in order to realize that there are some very serious and important problems for American business men and American citizens to solve, if we are really to maintain that freedom of opportunity and that square deal which have been held up as ideals by leaders of public thought.

All well informed business men understand that the business of banking, properly conducted, renders a great and a necessary service to the business community. It is well recognized, also, that a certain amount of concentration of banking capital is essential to handle the large-scale financial operations which are a necessary accompaniment of the large-scale industrial and transportation units of the present day. But when the man who is by general consent the most prominent figure at the financial center of the United States frankly admits that consolidation of banking capital has gone about far enough and that this consolidation at its present stage, if administered by bad or incompetent men might wreck the country, it is surely time for thinking men to inquire as to the conditions under which we are living and working.

It is certain that the public receives with no satisfaction these revelations of vast power, and of the huge profits which are being made by these past masters of finance. Notwithstanding the assurances that conditions are all right because the men who are in control are good men, the public is without doubt exceedingly skeptical as to whether these men are good enough to wield such great powers. It is exceedingly skeptical as to whether the huge profits which are flowing into the vaults of a few Wall Street banking houses as a tribute paid by the industries in fifty states of the Union and a world-wide commerce do not represent a return out of all proportion to the service rendered.

It must be clearly understood that the present concentration of power in the hands of a few Wall St. financiers is one of the penalties the public has to pay for the carnival of consolidation which went on in the early years of the 20th century. Whether the results of that consolidation were good or evil, we need not now stop to discuss. We need only direct attention to the fact that when a banking firm had financed the purchase of 20, or 40, or more mills engaged in an industry and established a central organization for carrying on their operations, the banking firm was obliged to undertake more or less responsibility for the conduct of the organization. The public which had bought the stocks and bonds largely on the strength of the banker's reputation looked to the banker to see that the promised returns on these securities were obtained. Almost automatically, therefore, the banker came into control of a property of which in many cases he owned comparatively little. It was the banking firm, naturally, which sought the proxies of the stockholders and could obtain them far more readily than anyone else. It was the banking firm, therefore, which selected the board of directors of the new trust and who not seldom instructed this board what officers it should choose and what policies it should pursue.

If anyone thinks that this was on the whole a great benefit to American industry, it would be well for him to contemplate the long list of bankruptcies and receiverships which followed in the train of that financial carnival of 1900 to 1906. If this be not sufficiently convincing, he is invited to review the situation in which American industry finds itself today. Is it any wonder that wealth gravitates into the hands of a few men? What other result could be expected when unlimited powers have been placed in their hands?

One is amazed, perhaps, at the enormous volume of the deposits held by a few great banks at the financial center. Seven of them have combined deposits of $1,400,000,000. Whence come these enormous sums of money? Does anyone imagine that this huge volume of deposits is concentrated in these banks as a result of open competition with their business rivals? Is the service rendered by these banks to their customers so superior, is the personality of their officers so attractive, or what is the reason that so large a proportion of the total banking capital of the United States is concentrated in the hands of a half dozen great institutions located at this financial center?

There is no great difficulty in solving the mystery when it is perceived that a large proportion of these deposits are under the banker's own control. The directors which he places in office fully understand where their companies' surplus funds are to be concentrated.

Why do those who seek to establish new enterprises in the smaller cities of the country find it necessary to come to New York and go hat in hand to the bond houses in order to obtain capital? Is it not, in part at least, because the capital, which thirty years ago the local mill, or shop, or factory used to deposit in its own local bank, is now kept at the financial center, where the people who control the organization that owns what was formerly the local mill or factory can use it for their own purposes?

This, however, is only the beginning. If truth must be told, it is probable that the enormous profits scooped in so easily by the high-finance manipulators of ten years ago have permanently spoiled them, so that they are no longer satisfied with the legitimate profit to be gained by legitimate banking. What corporation nowadays attempts to obtain money by offering its own stock and bonds to its stockholders and to the public when it desires to obtain additional capital? Where would there be any opportunity for profits to the bankers if this plan of financing were followed? The corporation may be in ever so good a position financially, the financial operation may be nothing more than exchanging new notes for old, or new bonds for old ones; it must, nevertheless, be done through the bankers.

We are well aware that there are arguments in favor of such a course in many instances, and it may even be that there is in some cases a certain amount of competition between some of the smaller banking houses for such financial business. But where a banking house controls a corporation, names its directors, and does its financing, who is to say how large a slice out of the corporation's treasury should be awarded to the banking house as its commission? One does not require a long memory to recall some famous (or infamous) instances of this sort of robbery of investors which filled the honest men and honest bankers of Wall Street (for there are many such there) with high indignation.

And we may say here parenthetically that if one wishes to hear a scathing arraignment of the "money trust" situation it is not necessary to go to the halls of Congress, nor to Texas, nor to Arkansas, nor Nebraska. One can obtain far more definite knowledge as to the real evils in connection with concentrated financial control from

men of high reputation for honesty and probity, who have done business in Wall St. for many years, and who know from first-hand knowledge how the game is played.

There is a comparatively recent Wall Street invention which has never been the subject of a patent, but which as a profit-yielding machine to the banking fraternity beats anything in the entire range of mechanical engineering. This invention is known as the short term note.

Its use on a large scale for corporation financing began about half a dozen years ago. At that time it was alleged that the public would no longer subscribe for additional stock issues and would only purchase bonds at a rate of interest higher than it seemed advisable for the companies to pay as a fixed charge. It was at that time declared, very likely in entire honesty, that instead of selling bonds at perhaps 5% or even 5½% to run for a period of ten years or more, it was better for corporations to provide for their immediate financial necessities by issuing notes for short terms, and before these notes came due it was argued that interest rates would go down and the bond market would improve so that the financial necessities of the companies could be provided for on better terms.

That was half a dozen years ago, but the short-term note is with us yet. In fact, some hundreds of millions of dollars of the obligations of corporations controlled in Wall St. is represented by short-term notes. Corporations not subject to Wall St. control are able to sell bonds, at a higher rate of interest, it is true, than prevailed in the '90's, but so far as can be seen, this higher rate of interest is likely to be with us for years to come and perhaps for many years to come.

Whenever these short-term notes become due, the company raises the money to pay them by issuing another lot of short-term notes, selling them to the banker, of course, who sells them to the public and reaps his commission on the transaction.

It will be seen by this wonderfully simple invention that instead of securing one commission on an issue of bonds which may run for 10, or 20, or 50 years before maturity, the invention of the short-term note enables the banker to exact a percentage on the debt of the corporations he controls every one, or two, or three years, whenever their issues of short-term notes fall due.

There are other ramifications in connection with the concentration of control of which it would be difficult to cite specific instances in print, but which are well known to many who hold executive positions in connection with industrial and transportation enterprises. It is, of course, evident that when the same interest controls a railway and also controls an industrial plant, or a dozen industrial plants from which that railway makes large purchases, it is to be expected that the railway patronage will go to these plants rather than to their competitors. It may even be for the interest of the directing power that the manufacturing company shall make large profits and the railway company small ones, or the reverse may be the case.

Probably the distinguished financiers who testified before the Pujo Committee would claim that the men who wield this enormous power are such good men that nothing of this unrighteous sort ever actually happens. Those who hold high executive positions in some of our corporations might tell a different story if the secrets of all hearts were revealed; but it is at least indisputable that this concentration of control which we are discussing makes a possible a most serious limitation in the field of equal opportunity in the not unthinkable case that bad men might come to wield this enormous power.

Much more might be said with respect to this matter; but there is another equally serious aspect of banking consolidation which deserves consideration. Not alone has the progress of consolidation of banking concentrated banking capital in New York, but the exploits of high finance in banking circles have in a large degree spoiled the banking fraternity for the pursuit of legitimate and conservative banking and have led bankers everywhere to emulate the methods of the Wall St. promoter. In an address delivered by John Harsen Rhoades, himself a Wall St. banker, before the New York City Finance Forum last month the following incident is recorded:

> Let me tell you another story: Just previous to the panic of 1907 my firm, a borrower of money from a large trust company, was informed that the rate on the loan had been raised to 50%. The collateral consisted of gilt-edged bonds, and the loan had been standing for some time. Knowing one of its officers—as a matter of fact—a personal friend, I called upon him, and among other things said: "Is not my credit sufficiently good to warrant a lower rate than 50%? You are a lender of money with a service to perform. Do you think it just to bleed me?"
>
> He replied: "I agree that such rates seem extortionate; but we are not facing a theory but a condition, and it is the duty of an officer of this company to its stockholders to take advantage of every opening that presents itself."
>
> Now, gentlemen, from his standpoint he was not dishonest, nor was he doing wrong. He was merely taking advantage of his opportunities. The fault lies where? Not with him, but with his conception of his duty to his stockholders versus service to the public and with a banking system that invited him to do as he did.

This incident related by Mr. Rhoades, it seems to us, emphasizes the wrong position in which the banking business stands today. Under a proper banking system the ideal should not be the rolling up of 20%, or 40%, or 100% dividends for the holders of bank stock in the manner for which Wall St. has set a precedent.

It is argued that the bank has a right to take any rate of interest which the borrower is willing to pay, and that the law of supply and demand should govern. The flaw in this argument lies in the fact that to a large extent the supply is in the control of the lender, and that by creating a condition of apparent scarcity he can make the rate of interest depend upon the borrower's *necessities* and not at all upon the relation between supply and demand.

It is surely a higher conception of the banker to consider him as a semipublic official, intrusted by the community with a reservoir of capital and credit, and with the judicial responsibility upon him of treating with absolute fairness and impartiality all the interests in the community. Such a bank and such a banker renders a community an enormous public service, but the banks and bankers which aim to be the masters instead of the servants of the public can bring a community or a nation to disaster.

As to what remedies are available for the condition of affairs which we set forth, we shall not at this time discuss. That the situation is one exceedingly difficult to better by any sort of governmental control will be admitted by all who have given careful study to the matter.

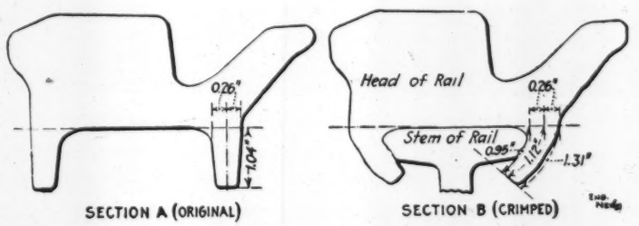
The first step, however, is to understand the situation which at present exists, and the obstacles which stand in the way of that equality of opportunity which the public demands, and properly demands, should prevail.

LETTERS TO THE EDITOR

Compound Rails on Chicago Street Railways

Sir—In ENGINEERING NEWS of Sept. 28, 1911, and Feb. 1, 1912, the writer gave some details in relation to the first mile of compound rails of the Romapac system* installed in Chicago. Since the latter date, three more miles have been laid for the Chicago City Ry. Co. and the Chicago Railways Co., and further tests have been made of the completed rail.

The basis of the system is the crimping of the flanges of the channel-shaped head section onto the bulb of the base section in such a manner as to convert the depending flanges of the former into springs. This is effected by causing a cold flowing of the metal under the pressure of the crimping rollers until the tension strains developed in first bending the flanges are converted, in the outer portion of the flanges, into compression strains, which give a spring grip that resists a shearing stress of over 36 tons to the foot. Measurements of the change effected in the cross-section of the flanges by this process have been taken by R. W. Hunt & Co., and are given in the following report:



SECTIONS OF HEAD OF ROMAPAC COMPOUND RAIL BEFORE AND AFTER BEING CRIMPED TO THE LOWER PORTION OF THE RAIL

The section termed *A* (shown in the cut) was an original section of which the flanges were not crimped. The section *B* was one consisting of both the head and the base section, in which the head section had been formed to the base section, in the track. The lengths of the flanges were measured and are given in the table.

Length inside of flange before crimping	1.04 in.
Length inside of flange after crimping	0.95 in.
Length center of flange before crimping	1.04 in.
Length center of flange after crimping	1.12 in.
Length outside of flange before crimping	1.04 in.
Length outside of flange after crimping	1.31 in.
Permanent contraction inside of flange	0.09 in.
Permanent elongation center of flange	0.08 in.
Permanent elongation outside of flange	0.27 in.
Per cent. of contraction inside of flange	8.65%
Per cent. of elongation center of flange	7.69%
Per cent. of elongation outside of flange	26.0 %

The writer believes that the above are the first published data on the cold deformation of rail steel and the conversion of the energy of deformation into a form of potential energy akin to that of a spring.

WM. A. DEL MAR,
Electrical Engineer.
70 E. 45th St., New York, N. Y.
Jan. 3, 1913.

*Described also in our issue of May 24, 1906.

[One effect of the crimping of the flanges is to cause the rail head to buckle or bend transversely, as noted in our issue of Nov. 28, 1912.—Editor.]

The Code of Ethics Drafted for the American Society of Mechanical Engineers

Sir—The proposed code of ethics for engineers, published in your issue of Jan. 2, is the best which I have ever seen. It is short and comprehensive. The committee has done the profession an important service in drafting this code, and I hope it will receive proper consideration by the various engineering societies.

ALBERT J. HIMES.
Cleveland, Ohio., Jan. 10, 1913.

The Status of the Engineer

Sir—I have read with interest your valuable editorial in the issue of Jan. 2, on the "Status of the Engineer," wherein you review this very important subject and "take stock" of the standing of the profession not only as to its inner shortcomings and merits, but, what is very much more to the point, its standing before the public. As I view it, the inner troubles are largely in the hands of the engineer body itself to cure and may be briefly stated as, (1) lack of homogeneity and team work, (2) little regard for ethics, (3) a very decided tendency toward commercialism as to services.

Now, let us examine the standing of the engineer before the public. This, as you say, leaves much to be desired. Engineers should have more voice in the settlement of important public questions, yet they are seldom heard as individuals, and then with but scant interest. Men who are aggressive and active in this profession, seem to lose these qualities before the public. Is it a constitutional want of some element in the technical mind, or is it a matter of training? My personal belief is that it is largely due to the conditions under which young men begin and continue work through their engineering life; the individual is suppressed as a part of some large organization, and if in later life independent practice is reached, the suppression has become a habit. Whatever the cause, individual initiative in public and business matters is but seldom found among engineers. It would seem, then, that local and, possibly in some instances, national engineering bodies must be looked to to make an impression on the public mind, and to raise the profession above its present status.

In order that this may be done comprehensively, it is advisable as a first step, to take up and provide a cure for what I have designated as the inner troubles. Never can the profession take its proper place before the public until it presents a united front as a homogeneous body with unalterably fixed ideas as to right and wrong. It

must have full knowledge of what it has a right to expect from or to give to the public and its clients, not in any sense as a labor organization, but as a body of men actuated by high principles of right and justice. It must protect the public, in so far as it can, from improper practice, and must sustain honest efficiency.

The starting point is a uniform code of ethics for the whole profession. Having adopted such a code, its enforcement by local and national societies should be taken up under such wise regulations as may be established for this purpose.

In order that such a code should be thoroughly understood and looked upon as an asset of the profession, our engineering schools should instill its principles into their students, as thoroughly as any other branch of the course, and during every year of the curriculum.

In addition to the code of ethics, such other standards and regulations as to practice as stated by Percival M. Churchill in his excellen letter, printed with your editorial of Jan. 2, would go a long way toward solidifying the engineer body and prevent some of its most unfortunate troubles.

In a few years, conditions of work under such a system as outlined above, would unquestionably bring about an improved status of the profession, not only within itself, but before the public. At the present time the profession is drifting without clearly defined ideas or standards. The overburden of young men taking up engineering work, is making the situation increasingly difficult, as competition for work does not tend to professionalism but to commercialism. Prompt action is necessary and the times demand it.

G. B. HAZLEHURST.

Catonsville, Md., Jan. 13, 1913.

The Question of Impact on Bridge Substructures

Sir—In designing a railway bridge, proper allowance for "impact" is invariably made in the computations of stresses in the main members. The same care is taken in designing a tower or a bent carrying such a bridge.

The impact stress is sometimes figured by one of several formulas known to and generally accepted by bridge engineers; and sometimes it is determined by taking certain percentages of the live-load stresses. Some text-books attempt to discuss the subject and try to arrive at a mathematical conclusion, though none as yet has been able to present a theoretical formula which may be substituted for the empirical formulas now in use. Engineers of wide repute study the question from time to time and inform the engineering profession of their experiments and conclusions. Engineering associations appoint committees, solely for the purpose of investigating the important question of impact. In the absence of a correct theoretical formula, the engineering profession seems to be well satisfied with the data at hand, taking refuge in the statement that in this matter experience is in advance of theory.

But all these formulas, reports, conclusions and recommendations concern only the superstructure. The writer does not recollect any source of information which treats of the impact effect upon the substructure and the foundations. It is true that there are cases in which the dynamic effect of a moving train upon the substructure, especially upon the foundations, is practically a negligible quantity. Yet there are many cases when this force cannot be very well overlooked.

There are several different ways in which the effect of the impact stress upon the substructure or foundations may be considered. Take the case of a low pier on pile foundations, supporting two adjacent trusses or girders of such spans as to give a considerable amount of impact reaction. In determining the number of piles under this pier the end reactions of the trusses or girders resting on it form one of the important forces. The impact, of course, contributes considerably to the reactions; and it is very evident that in computing the number of piles this portion of the reactions cannot be omitted. On the other hand, the direct impact on top of the pier cannot be taken in full in the same computations.

The case of a pier is not much different from that of a tower as regards the relation between impact and dead-load; and if we agree to determine the amount of impact stress by a formula in which the dead-load is one of the factors, the problem may be partly solved, although not for all cases. Taking the formula $I = \frac{L^2}{L+D}$, in which I is the impact reaction, L the live-load reaction and D the dead-load reaction, the most logical procedure would be to modify the expression by changing it into $I' = \frac{L^2}{L+D+M}$, in which I' is the impact reaction on top of foundation area, L and D live- and dead-load reactions, respectively, and M the weight of masonry.

The same reasoning would be applicable to abutments without wings, were it not for the effect of the impact directly on top of the ballast wall. The analysis of this impact stress is rather difficult, for the reason that several indeterminate elements enter into the problem, such as the speed of the train, time in which the impact stress is generated, curvature of the track, etc.

Again, the effect of impact upon the wings of an abutment and upon the foundation area of these wings may require careful consideration; especially so with T and U abutments, as in the case of T-abutments the tail-wall is directly under the track and in the case of U-abutments the wing-walls as a whole are nearer the track.

When the pier or abutment is so high that the weight of masonry is very large compared with the live-load reaction, the effect of impact upon the foundation area becomes an insignificant quantity. This can easily be seen from the preceding formula, in which the larger the value for the dead-load reaction D, the smaller the result for the impact reaction I. It is rational also to conclude that when such a solid mass of masonry like a high pier or high abutment is subjected to dynamic load, the impact effect would naturally decrease with the height of the pier or abutment and almost vanish at its base.

C. M. LUTHER.

Toronto, Ont.,
Dec. 28, 1912.

This space was intended for an interesting inquiry, but we find that the author signed it "A Subscriber," without giving his name. The old rule is that no notice may be taken of anonymous communications; the rule is still good, but especially so in the case of letters with the above signature.

The Present Status of the New York State Barge Canal

The greater part of the annual report of John A. Bensel, State Engineer and Surveyor of the State of New York, for the fiscal year ending Sept. 30, 1912, is devoted to a discussion of the past work on and future necessities of the Barge Canal, which has been in course of construction for the last eight years. In the main the report is a statement of the inadequacy of the $127,800,000 appropriated by the state for the full completion of the canal and its accessories. The leading portions of the report follow:

There has been much speculation as to when the Barge Canal will be completed and whether or not, when completed, the cost of the improvement would be within the original appropriations of $101,000,000 for the improvement of the Erie, Champlain and Oswego canals, and of $7,000,000 for the improvement of the Cayuga and Seneca Canal. I deem it my duty as State Engineer and Surveyor to place before the Legislature and the people of the state a statement setting forth what to my mind is the exact status of this underaking, such judgment being based on the progress made to the end of the fiscal year Sept. 30, 1912.

From an examination of the status of the work it is apparent that the construction of the Barge Canal is progressing at a rapid rate, in that to Oct. 1, 1912, there had been placed under contract work to the amount of $77,029,116, and there had been completed work amounting to $50,684,369. The construction work is more than 60% completed, and more than 50% of the work completed to date has been done during 1911 and 1912.

Plans for the work remaining to be placed under contract are practically completed, and such work as is included therein will be awarded at an early date, such as to permit the completion of the entire Barge Canal system and have this extensive waterway ready for navigation probably in the year 1915.

ERIE, CHAMPLAIN AND OSWEGO CANALS

PROGRESS OF WORK—At the rate with which the work is being and has been progressed, there was every reason to believe that the Champlain Canal would have been entirely completed and ready for navigation in the year 1913, but owing to the failure on the part of certain contractors performing work on this portion of the canal it has been necessary for the Canal Board to cancel certain contracts and to readvertise for the uncompleted portions of such work. The best to be expected is that this portion of the Barge Canal system may be completed in 1914.

There is every reason to believe that the Barge Canal between the Hudson River and the city of Oswego on Lake Ontario, the terminus of the Oswego Canal, will be completed and in readiness for navigation in 1914.

The progress of the work on that portion of the canal west of the junction of the Oswego and Erie canals at Three River Point is such as to warrant the expectation of having this section of the system completed in 1915, thereby placing that portion of the Barge Canal, including the Erie, Champlain and Oswego Canals, in condition for navigation during the season of 1915.

To Oct. 1, 1912, many of the Barge Canal contracts had been completed and certain sections of the improved canal used as a part of the canal system. Upon the resumption of navigation in the spring of 1913 there will be completed approximately 140 miles of the improved Barge Canal.

FINANCIAL—After having made an investigation of the possible cost for constructing a Barge Canal, a report was submitted to the Legislature in 1901 by the then State Engineer, setting forth the estimated cost of construcion along the various routes as then contemplated. In 1903 the then State Engineer, in answer to certain questions contained in a resolution adopted by the Assembly on Feb. 10, 1903, submitted certain data in which the total estimated cost of the Barge Canal project was fixed at $100,562,993, based upon the prices for labor and material governing at the time of making such report. With this information at hand the Legislature of 1903 authorized the issuance of bonds to the amount of $101,000,000 for carrying out the work, which, having been submitted to the people, was approved at the Fall election of that year.

It should be borne in mind that the prices of labor and materials have increased to a considerable extent since the enactment of the Barge Canal law; that the size of the locks has been increased by widening from 28 to 45 ft.; that the grade has been lowered by legislative enactment between Tonawanda and Lockport and the rock cut at Lockport widened; that this work was done without additional appropriation, but has added to the cost of construction approximately $4,500,000; and further, that recent legislative enactment now requires certain increased fixed charges such as bonds and liability insurance, which, of course, must eventually be paid by the state, as they are included in the bids received for the various contracts.

To offset a portion of this added burden the appropriation of 1903 has been relieved to date of the construction of the canal from Tonawanda to Buffalo, the construction of the Troy dam, and a slight decrease in the expense of the work east of Lockport, due to changing the grade of the canal; the saving as a result of which items is estimated at $3,500,000.

It is my opinion that the cost of the actual construction as contemplated in 1903 and the cost of engineering in the preparation of plans and specifications and the supervision of construction appertaining to this improvement will be performed within the estimated amount for such items, but that the whole project as contemplated by Chapter 147 of the Laws of 1903 and amendatory acts cannot be completed within the original appropriation of $101,000,000. The principal excess in the cost of this undertaking is in connection with the appropriation of lands and structures, together with damage to water powers and riparian rights, for which items the allotment in the 1903 estimate appears to have been greatly deficient.

Summarizing the cost estimates of 1903 and 1912 we find:

	1903	1912
Total estimated cost of construction	$77,572,906	*$83,293,872
Railroad bridges	4,042,765	4,401,173
Engineering, administration and contingencies, Comptroller, and Superintendent of Public Works, etc.	11,793,273	9,500,000
	$93,408,944	$97,195,045
Increased cost, due to burden added without additional appropriation		4,500,000
		$92,695,045

*Includes certain work covered in 1903 contingent item.

This estimate of $97,195,045 does not include the item of $3,445,000 for the estimated cost of constructing bridges at points where there are existing bridges over the present canal, inasmuch as the question as to who shall defray the expense of such construction has not as yet been definitely determined. Deducting from the total estimate for 1912, as stated above, the items of increase in expense by reason of additional burdens, amounting to $4,500,000, placed upon the Barge Canal appropriation by reason of legislative enactment without providing for additional appropriations, it will make the present estimated cost of construction within the 1903 estimate covering the same territory.

From these figures it is therefore apparent that there is approximately $3,800,000 available with which to make payments in settlement an account of the appropriation of lands and water-power rights. The total estimated cost of the right-of-way in 1903 was $4,712,114, and it was estimated that the state would realize from the sale of abandoned lands the sum of $1,966,391, leaving a balance estimated for the payment of land damages of $2,745,723. The 1903 estimate included an item of $188,500 for paying riparian damages to property owners along the Oswego river, it being held the estimated cost of lands would be sufficient for the payment of riparian damages at other points. The total net estimated cost, therefore, of lands and water-power rights in 1903 was $2,944,223, after deducting the estimated return from the sale of abandoned canal lands.

In view of the uncertainty as to the position to be taken by the courts in the consideration of claims for damages on account of water-power appropriation, no attempt has been made to estimate the probable amount necessary to settle such claims. Inasmuch as a great many settlements have been made by the Special Examiner and Appraiser of awards made by the Board of Claims and the Court of Claims on account of appropriation of lands and buildings, such settlements of awards have been taken into consideration and by a comparison in connection with adjacent property which has been appropriated for canal purposes and for which settlements have not been made, a conservative estimate of the cost of lands necessary for Barge canal construction is placed at least $8,000,000, this figure not including any item on account of water-power settlements.

The State Comptroller has already made disbursements on account of Barge Canal construction, approximating $58,000,000. During the coming year a greater number of the large

contracts will be completed and it will be necessary for the state to make final payment. In addition to this the expenses of the different departments for administration, etc., must be met and the awards made by the Board of Claims and settlement agreements made by the Special Examiner and Appraiser must be paid.

It would, therefore, seem that within the course of the next two years, unless some action is taken by the Legislature, a condition will exist wherein the total appropriation of $101,000,000 will have been exhausted and the state will be under further obligations for expense for which there will be no funds available for payment. I, therefore, recommend to the Legislature the careful consideration of the enactment of some legislation to the end that funds shall be available when the same shall become necessary with which to meet this additional expense above the $101,000,000 heretofore authorized, which excess in expenses is due principally to the increase in the cost of lands and waters taken for Barge Canal purposes above the estimate of 1903.

CAYUGA AND SENECA CANAL

Chapter 391, Laws of 1909, appropriated the sum of $7,000,000 for the improvement of the Cayuga and Seneca Canal. This act provided for the improvement of this canal to Barge Canal dimensions the same as those for the Erie, Oswego and Champlain Canals. The work embraced in the Cayuga and Seneca improvement will be completed at such time as to permit of the navigation of this part of the Barge Canal system upon the completion of the Erie Canal system, namely, in 1915.

TROY DAM

The attention of the Legislature was called in my report for the year 1911 to certain conditions governing in connection with the construction of a dam across the Hudson River in the vicinity of Troy, which dam will be the key to the Barge Canal system of the State of New York.

Your honorable body is undoubtedly familiar with the steps taken by the former Canal Board toward canceling leases for the use of surplus waters at the site of the present dam and of the action on the part of the Federal authorities in assuming jurisdiction over the upper waters of the Hudson River and of the construction of a dam at the point in question. Accordingly the Federal authorities proceeded with the preparation of plans and specifications for a dam and lock to be constructed in the vicinity of Troy, approximately 1400 ft. above the site of the present dam. Proposals were invited for carrying on this work in accordance with the plans prepared, but no bid was received which approximated the estimate of the army engineers close enough to warrant the award of such contract. As a result, the United States government has determined to proceed with the construction of this dam with their own forces.

It is important that the Troy dam shall be completed as soon as the Barge Canal is completed in order to permit boats of Barge Canal dimensions to be locked through from the upper pool to the Hudson River below the Troy dam.

At the site of the Troy dam it will be possible to install a power development plant of considerable size, and there will be available for sale a large amount of power. This dam being within the bounds of New York State, it would appear just and proper that any revenue derived therefrom should properly be paid into the treasury of the State of New York, and furthermore, that the State of New York should have control over the structures at the entrance to the Barge Canal system.

I would, therefore, recommend for your careful consideration the questions arising in connection with the Troy dam situation, to the end that, if so deemed advisable, the necessary steps may be taken and an endeavor be made to return to the control of the State of New York the construction of and jurisdiction over the Troy dam, together with the disposal of power available at the site of this structure.

BARGE CANAL TERMINALS

Chapter 746 of the Laws of 1911 authorized the issuing of bonds in the amount of $19,800,000 for the purpose of constructing terminals for the Barge Canal system throughout the state. This act was approved by the people in November, 1911.

To the end that the various localities might be provided with terminals which would conform to the plans for the Barge Canal construction and at the same time meet the commercial demands of the particular localities, public hearings and meetings, personally conducted by me, have been held at the various points where terminals are to be located, to the end that the desires of the people with respect to the location of terminals might be obtained.

To the end of the present fiscal year location plans for Barge Canal terminals for the following localities have been approved by the Canal Board: Ithaca, Albany, Little Falls, Utica, Gowanus Bay (South Brooklyn), Schuylerville, Schenectady, Rome, Lockport, Mechanicville, Fonda, Fort Edward, Greenpoint (North Brooklyn), Amsterdam, Erie Basin (Buffalo), Herkimer, Ilion, Troy, Constantia, Syracuse, Cleveland, Watkins, Port of Call (New York City) and Dresden.

Contracts have been entered into providing for the construction of terminals at the following localities: Ithaca, Albany, Little Falls, Mechanicville, Fort Edward, Schenectady and Herkimer.

The construction work on the terminals will be progressed with all possible speed.

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Annual Meeting of the American Society of Civil Engineers

Several live subjects came up for discussion before the annual meeting of the American Society of Civil Engineers, held in the society house in New York City, on Jan. 15, 1913. By custom, the annual meeting is devoted to business proceedings and to the reception and discussion of special committee reports, no individual papers being presented. At last week's meeting both the committee reports and the society business discussed contained matter of considerable importance. The second report of the joint committee on concrete and reinforced concrete was presented (but not discussed). The other technical committees, generally speaking, reported progress only; in doing so several of them which have been standing for a number of years illustrated anew the fact that in this society things move slowly.

Under the head of society business, several active professional questions were brought up for discussion, such as codes of ethics for engineers, engineering employment and rates of compensation, the formation of an engineering employment exchange based on a broad plan, the International Engineering Congress at San Francisco in 1915, further centralization of the society control (if such be possible), and, last but not least, ways and means of increasing the interest of the semimonthly meetings of the society.

The election of new members of the nominating committee and the officers of the society resulted as follows

Nominating Committee: S. W. Hoag (New York, N. Y.), Charles T. Main (Boston, Mass.), Edward A. Fisher (Rochester, N. Y.), Richard Khuen (Pittsburgh, Penn.), J. B. Berry (Chicago, Ill.), Frank M. Kerr (New Orleans, La.), and William Mulholland (Los Angeles, Calif.).

New Officers: President, Prof. George F. Swain, of Boston, Mass.; Vice-Presidents, J. Waldo Smith, of New York City, and C. H. Rust, of Victoria, B. C.; Treasurer, John F. Wallace, of New York City; Members of the Board of Direction, Henry W. Hodge and James H. Edwards, of New York City, Leonard Metcalf, of Boston, Mass., Henry R. Leonard, of Philadelphia, Penn., Edward H. Conner, of Leavenworth, Kan., and Samuel H. Hedges, Seattle, Wash.

The society prizes for the year ending July, 1912, were awarded as follows: The Norman Medal to W. S. Kinnear for a paper on the Detroit River tunnel; the Rowland prize to Eugene Klapp and W. J. Douglas for a paper on the Almendares River bridge, and the Collingwood prize to W. W. Clifford for a paper on reinforced-concrete standpipes.

BUSINESS PROCEEDINGS

Passing over the report of the Board of Direction and of the several officials, all of which showed the society to be in a very flourishing condition, the first matter of interest was the action on the request of last year to appoint a committee to investigate the conditions of engineering employment and compensation.

Engineering Employment and Compensation—The Board of Direction has approved the proposal that such a committee be appointed. The following have been named as members of this committee: Alfred Noble, S. L. F. Deyo, D. C. Jackson, W. V. Judson, G. W. Tillson, C. F. Loweth, and J. A. Bensel.

A further development in the same subject was agitated through a letter by P. M. Churchill (Boston, Mass.), who submitted a motion asking that the Board of Direction confer with other engineering societies with a view to determining whether it is possible to establish an exchange for marketing engineering services, and that in case of a favorable decision a committee be appointed to consider the subject. This motion, unfortunately, was brought up near the close of the session. Whether partly on this account or because the meeting was not interested in the subject-matter of the motion, it was promptly passed over without discussion, by reference to the Board of Direction.

Code of Ethics—This subject was also brought up by P. M. Churchill. He advocated (by letter) that, in view of the fact that a standard code of ethics is greatly needed, the society should consider the adoption of the code recently drawn up by a committee of the American Society of Mechanical Engineers but not yet acted on by that organization (the code was printed in ENG. NEWS., Jan. 2, 1913, p. 29). He proposed an intricate scheme by which action on this code and revision of the code could be secured without the appointment of a committee, through a letter ballot for opinion and suggestion as to revision, and a second letter ballot for adoption by sections.

This subject was also passed without discussion, being referred to the Board of Direction.

Method of Society Control—The Board of Direction presented a brief special report in which it advocated redistricting the society. At present the election of the nominating committee and of directors is carried on according to geographical districts, which theoretically are laid out to have approximately equal shares of the membership and to be representative of different territorial interests. There are at present seven such districts.

The Board of Direction proposed that the redistricting should be made so as to create a total of thirteen districts and that instead of two directors for districts there should be only one, elected as at present for two years, with the result that only half the total number of districts would elect a director in any given year. Inasmuch as the proposed change would require the constitution to be amended, the Board suggested that the subject be fully discussed by the meeting.

Besides an active discussion, this subject produced a pretty complex parliamentary tangle. The latter is well indicated by the series of votes as follows: First it was voted that the special report of the Board be approved and that an amendment as proposed be submitted to the society for vote. After some discussion it was then voted, quite without regard to the prior vote, that the plan to amend the constitution as proposed by the Board is desirable, but that consideration should be given to abolition of geographical restrictions from the election of officers. It was then separately moved to drop all mention of geographical divisions from the constitution, *but this motion was voted down almost unanimously.* It was finally voted that the whole matter be referred back to the Board of Direction, and that the Board be asked to recommend an amendment or series of amendments suited to the case. This conflicting set of motions evidently leaves the subject pretty much where it was before.

The discussion of the entire matter was quite active. Its chief result was to show that a certain number of members are in favor of dropping the scheme of division into geographical districts and regard this arrangement as being mere red tape, while a certain number of others strongly believe in the district plan as protecting the interest of the members living at a distance from New York. Speaking for the former party were G. S. Williams, R. L. Humphrey, S. Wninery, among others. The other party was represented by Prof. A. N. Talbot, N. P. Lewis, H. B. Seaman, and others.

Several auxiliary matters were injected. One of these was the matter of securing an adequately attended meeting of the nominating committee, and it was proposed that to secure a full attendance the members of the nominating committee be paid their traveling expenses to either the annual meeting or the summer convention of the society. It was also suggested that the members of the Board of Direction might be paid salaries, in the same way as the officers of a corporation are paid. These expenses-and-salary suggestions were made with direct reference to the fact, shown by the financial report, that the society's income exceeds its expenses by about $30,000 per year.

Other Business—A letter of E. W. Clarke, addressed to the Board of Direction, made the suggestion that the practice of reading papers at the semi-monthly meetings of the society be discontinued, on the grounds that this reading is a bore and that there is little discussion, the evening of the meeting being valuable chiefly for the social coming together of the members. As a means of making the meetings interesting he suggested that lantern slides of construction work in progress be presented, or other entertainment of an engineering character be offered, and that for the rest the gathering being treated as a social meeting. To carry out his suggestion he offered a motion that it be suggested to the Board of Direction that the Board take steps to find out whether engineering entertainment suitable for the meeting can be obtained.

A number of speakers, discussing the letter, actively seconded the proposal to inject a little more activity into the meetings. An amendment was offered to the effect that a committee be appointed to investigate the entire subject of handling the programs, considering even such questions as paying authors of papers, securing papers through direct invitation, etc. It was further moved that a committee of five be appointed to consider the entire subject of improving methods of presentation of papers. This motion was finally adopted.

H. M. Wilson called attention to the fact that this annual meeting overtaxed the capacity of the society house and that the inadequate facilities were alleged as the reason why a lunch is not provided there for the

members on the first day of the annual meeting. In view of these facts he moved that the Board of Direction be requested to consider plans for increasing the capacity of the society house to make it adequate for the annual meeting and the like. This motion was carried.

It was also voted that the Board of Direction be instructed to employ the best talent available to determine how the acoustics of the meeting hall might be improved.

Secretary Charles Warren Hunt reported the preliminary arrangements toward organizing the International Engineering Congress, which is to be held in San Francisco in 1915, at the time of the Panama-Pacific Exposition. The original suggestion for such a congress came from the Pacific Coast engineers, who proposed that the congress be conducted by the several national engineering societies jointly, each society conducting that part pertaining to its own work. The first final outcome was a financing plan which called for a local contribution of $10,000 and society contributions as follows: American Society of Civil Engineers, $9000; American Institute of Electrical Engineers, $9000; American Society of Mechanical Engineers, $5000; American Institute of Mining Engineers, $5000; Society of Naval Architects & Marine Engineers, $2000; a total of $40,000. However, the electrical society has to contribute heavily toward conducting the International Electrical Congress at the time, and on this account their contribution to the Engineering Congress is reduced to $3500. The organization and management is to be in the hands of a committee of 30, made up of delegates from the different societies (including in each case the president and secretary, *ex-officio*) and having the remaining representation of Pacific Coast members.

Technical Proceedings

The most important item of the technical program was the second report of the society's delegation on the Joint Committee on Concrete and Reinforced Concrete. The report, presented in printed form, was introduced briefly by R. L. Humphrey.

While the report is far too bulky for reprinting here (it covers 52 pages of the regular "Transactions" sizes), the following is a brief summary of the main points in which the new report differs from the first report rendered four years ago (January, 1909).

New Features of Concrete Report—A historical introduction and bibliography is added. An express caution is added that the report is not to be regarded as a specification, but may be used as a basis for a specification. Under the heading of Destructive Agencies the relation of *electrolytic disintegration* to the durability of concrete is stated quite fully in accordance with the most recent experimental conclusions. The qualities of *fine aggregates* are stated more fully; something is added on *high-carbon reinforcing steel*. The section on *Proportioning Concrete* is a little amplified. For *mixing*, a definite minimum length of mixing period is recommended, although no figure is given for this minimum. The deposition of *concrete under water* is discussed. Time of *removal of forms* is a little amplified. How to prevent *shrinkage and temperature cracks* is made the subject of a few paragraphs, handled a little differently from those in the former reports. The figures given for *modulus of elasticity* to be assumed under different conditions are somewhat modified; for example, a ratio of 8 is recommended to compute deflection where the former report stated 8 to 12, and different ratios are given for concrete of different normal strengths. A little more detailed specification of *T-beam proportions*, and stricter fixing of assumption for continuous or *constrained beams* or slabs, are provided. Slabs having *reinforcement in more than one direction* are honored by two paragraphs of discussion, containing numerous cautionary statements. More conservative statements are made on *bond strength*. A considerably revised discussion of *diagonal tension* and *shear* is presented. Several new features are found in the section on *Columns*, an important one being the omission of structural-steel reinforcement as one of the classifications. A table of *mean compressive strengths* of concretes having different kinds of stone and different proportions of mixture is given, with the recommendation that these values should be the maximum ultimate strengths on which designing should be based. The recommended *unit-stresses* for shear and diagonal tension are modified.

As already remarked, there was no discussion on the report.

Engineering Education—On this subject Desmond Fitzgerald presented an informal progress report. It appears that the committee is waiting for the Carnegie Foundation to make the necessary investigation on which a report may be based.

Steel Columns—A. L. Bowman reported progress for this committee. The full program of tests laid out by the committee is to be carried through by the U. S. Bureau of Standards, beginning shortly. The tests have been postponed by delay in getting ready the new testing-machine, but the machine is now in operation and about half of the test material has been purchased.

Bearing Value of Soils—The Board of Direction has decided to appoint a special committee on bearing value of different soils for foundations. The committee has not yet been completely made up.

Valuation of Public Utilities—F. P. Stearns, Boston, Mass., reported progress for the committee appointed to formulate principles to govern the valuation of public utilities.

Bituminous Material for Road Construction—The committee reported through W. W. Crosby. Essentially its report was a report of progress, but a number of suggestions and fragmentary recommendations were made. The committee defined bitumen in the same definition as used by the American Society for Testing Materials, the criterion being solubility in carbon disulphide. It also defines bituminous materials as materials containing bitumen. It may later fix limits for the maximum amount of distillate in tar up to 170° C. (different limits for different conditions of origin and use), limits for free carbon in tar for superficial treatment, etc. In addition to its definition of bituminous surfaces, etc., the committee presented a definition for bituminous-concrete pavement, the definition involving the mixing method of preparation. On the question of seal coats for mixture-method pavements the committee recommended further investigation. It renewed its recommendation of a year ago for drawing up a standard method of recording costs.

The report of the committee was not discussed, but the report was received and the committee continued. This same remark also applies to the reports of the other committees above noted.

The Portland Cement Specification of Lackawanna R.R.

As a result of an extended investigation the Delaware, Lackawanna & Western R.R. has decided to adopt a specification for the purchase of portland cement, which differs in some important features from the standard specifications adopted by the United States Government or by the American Society for Testing Materials. As announced in ENGINEERING NEWS, June 13, 1912, p. 1111, the main divergence is in the matter of soundness tests, for which the Lackawanna has adopted the "autoclave" boiling-pressure test, described in our previous article, instead of the ordinary boiling test prescribed by the usual standards. The full text of the specification, adopted Jan. 1, 1913, is as follows:

Definition

1. The cement shall be the product obtained by finely pulverizing clinker produced by calcining to incipient fusion, an intimate mixture of properly proportioned argillaceous and calcareous substances, with only such additions subsequent to calcining as may be necessary to control certain properties. Such additions shall not exceed 3%, by weight, of the calcined product.

Specific Gravity

2. The specific gravity of the cement shall not be less than 3.10.

Fineness

3. 95% of the cement, by weight, shall pass through the No. 100 sieve, and 80% of the cement, by weight, shall pass through the No. 200 sieve.

Time of Setting

4. The cement shall not acquire its initial set in less than 1 hour and must have acquired its final set within ten hours.

Soundness—Force Autoclave Test

5. Three neat briquettes to be made up in the usual manner and allowed to remain in the damp closet for 24 hours. At the expiration of that time, the briquettes are to be removed from the molds and placed in the autoclave, sufficient water being added to partly or wholly cover the briquettes. The autoclave is then closed, the burners being of sufficient size to raise the pressure to 295 lb. in not more than 1 hour. The pressure of 295 lb. shall be maintained for 1 hour longer, or a total time of 2 hours. The pressure is then to be gradually released, the briquettes taken out and placed in the moist closet, where they shall be allowed to remain for 1 hour. At the end of that time they are to be broken in the standard cement-testing machine in the usual manner. The average tensile strength of the three briquettes taken from the autoclave must show a tensile strength of not less than 500 lb. per sq.in. They must also show an increase of not less than 25% over the average tensile strength of three briquettes broken at the end of 24 hours. A bar of neat cement, 6 in. long by 1 in. square, shall be made up at the same time the briquettes are made. This expansion bar to remain in the moist closet for 24 hours and to be removed along with the briquettes and tested with the briquettes in the autoclave, as indicated above. After one hour in the moist closet, this expansion bar shall not show an expansion greater than ½%.

Tensile Strength

6. The minimum requirements for tensile strength for briquettes 1 in. square in section shall be within the following:

Age	Neat Cement	Strength
24 hours in moist air		200 lb.
7 days (1 day in moist air, 6 days in water)		500 lb.
28 days (1 day in moist air, 27 days in water)		600 lb.
	One Part Cement, Three Parts Sand	
7 days (1 day in moist air, 6 days in water)		250 lb.
28 days (1 day in moist air, 27 days in water)		375 lb.

The average of the tensile strengths developed at each age by the briquettes in any set made from one sample is to be considered the tensile strength of the sample at that age. Any results that are manifestly faulty will not be included. The sand briquettes will be thoroughly tamped in the molds by using an iron die to fit inside the sand briquette mold, this die to be struck a number of blows with a wooden mallet.

Composition

7. In the finished cement, the following limits shall not be exceeded:

[Limits shown in table at top of next column]

	Per Cent
Loss on ignition for 20 minutes	4
Insoluble residue	1
Sulphuric anhydride (SO_3)	1.75
Magnesia (MgO)	4

8. The insoluble residue shall be determined on a 1-gram sample which is digested on the steam bath in hydrochloric acid of approximately 1.035 specific gravity until the cement is dissolved. The residue is filtered, washed with hot water, and the filterer paper contents digested on the steam bath in a 5% solution of sodium carbonate. The residue is then filtered, washed with hot water, then with hydrochloric acid, approximately of 1.035 specific gravity, and finally with hot water, then ignited and weighed. The quantity so obtained is insoluble residue.

Inspection

9. All cement which is used by the above named company, or any contractors doing work for the above named company, must be sampled at the mill. The inspector will take a sample from each and every car and properly seal the cars with the company's seals.

In no case must cement be shipped from any mill without the company's inspector being present. Should it be necessary at any time to ship cement without inspection at the mill, but which inspection will be made at point of destination, the shipper must so notify the chemist and engineer of tests, and receive special orders from him for the shipping of the cement.

The inspector must have access to all parts of the mill, either day or night, when any contract is being filled for the company.

The shipper must furnish the office of the chemist and engineer of tests with analysis and physical tests showing results obtained upon the bin from which shipments are made.

Samples taken from every car will be sent to the laboratory for further test and inspection. Any sample which fails to meet any or all of the above requirements will be condemned and returned to the shipper, who must pay freight charges in both directions.

Samples of cement obtained from cars which continue to show a lower result at the end of the 28-day sand test than is shown in the 7-day sand test will be sufficient cause for the canceling of any contract which at that time may be in force.

The following tabulation shows the main divergent items between the above specification and that adopted by the American Society for Testing Materials. The comparison is made by the editors of ENGINEERING NEWS and is not a part of the above specification.

	Lackawanna	Am. Soc. T. M.
Fineness—Through 100 mesh	95%	92%
Through 200 mesh	80%	75%
Initial set	<1 hr.	<30 min.
Soundness	Autoclave	Air and Boiling
Tensile strength:		
Neat—24 hr	200 lb. per sq.in.	175 lb. per sq.in.
1:3—7 days	250 lb. per sq.in.	200 lb per sq.in.
1:3—28 days	375 lb. per sq.in.	275 lb. per sq.in.

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Reduced Gas Rates will become effective throughout northern New Jersey on and after May 1, as the result of conferences between the Public Service Gas Co. and the State Board of Public Utility Commissioners. For many weeks the Commission has been studying the investment and operating expenses of the Passaic Division of the Public Service Gas Co., and recently rendered a decision that a rate of 90c. per 1000 cu.ft. for this district would be reasonable. The valuation of the company's property and business was placed at $5,775,000, compared with $12,000,042, as claimed by the company. The difference is partly in the items of special franchises, which were rejected. A contention that the evaluation should not fall below the par value of securities issued, in a merger of six companies dating before the present company's lease, was also rejected.

The company accepted the order of the commission fixing the price at 90c., but reserved the right to test at its convenience the legality and constitutionality of the Board's principles of valuation.

The Commission also recommended that the price of gas be reduced from $1 to 90c. throughout the entire area served by the company in the state and this recommendation was accepted by the company pending the termination of litigation of principles of the valuation. The device of the company to adjudicate the difference in principles of valuation, was commended by the Commission.

Drainage Area and Population of the Ohio River Valley and Pollution of the Ohio River

By A. H. Horton*

The drainage basin of the Ohio River comprises parts of 14 states, not one of which lies wholly within the basin. Table I gives the area and percentage of the total area of each state within the basin; also the rural, urban and total population, and the percentage each is of the total in each state.† It is of interest to note that the percentage of each state's total area and the percentage of each state's total population within the basin agree quite closely, with the exception of the State of Illinois.

Table II gives the area, rural, urban and total population and the percentage each is of the total in the basin for different points along the Ohio River.

An examination of Table No. II will convince any one of the necessity of treating the Ohio River water before using it for a municipal water-supply.

The International Waterways Commission, under date of Jan. 4, 1907, states that "the latest conclusions of sanitary engineers as to the amount of dilution which is required to make sewage inoffensive are that a dilution of 3⅓ cu.ft. per sec. per 1000 persons connected with the sewers is as low a figure as it is now possible to state." At the Ohio-Pennsylvania state line the minimum flow of the Ohio River in 1908 was approximately 1100 sec.-ft. At the present time probably not all towns of 2500 population and over in the Ohio Valley are provided with sewers. The percentage of urban population in towns between 2500 and 5000 population is small, for in Ohio and Kentucky the urban population in cities between these limits is but 12 and 9%, respectively, of the total urban in each state; towns of 5000 population or over generally have more or less complete sewer systems. Perhaps not more than 75% of the population in sewered towns are provided with sewers, depending upon how rigidly the municipal authorities enforce the laws which most cities have that sewer connections must be made. It is not thought necessary, however, in this brief discussion to enter into modifying details, as the reader may use whatever coefficients he thinks advisable to reduce the data to actual conditions. Assuming, therefore, that all the urban population is connected with sewers, since it will not be so very long before this will be practically true, the flow at the Ohio-Pennsylvania state line should be 1626 times 3⅓, or 5420 sec.-ft.; the minimum flow of the Ohio River in 1908 at the point under consideration was, therefore, only one-fifth of that required to make the sewage in the river inoffensive.

Above the mouth of the Little Miami River (intake of Cincinnati water-works) the urban population is 2,524,000; the minimum flow at this point in 1908 was approximately 5000 sec.-ft. The amount required for proper dilution is 8400 sec.-ft. At Evansville, Ind., the minimum flow in 1908 was approximately 8000 sec.-ft.; the urban population above this point is 3,762,000. The flow required is 12,500 sec.-ft.

The above figures, with the assumption as stated, show that at no point on the Ohio River is the minimum flow sufficient to render the sewage that enters the river inoffensive. Under the conditions that prevail at ordinary low-water stages perhaps little of the sewage from the State of Pennsylvania arrives as far down the river as Cincinnati or Evansville. But if a long continued

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†Urban population, as defined by the 1910 Census, is the population in towns of 2500 or over.

Population data in Tables Nos. I and II were taken from the 1910 Census. Areas were taken from Rand & McNally's Atlas, 1908. Population and area were worked up by counties. The distribution of the rural population was assumed to be proportional to each county's area where the outline of any drainage area passed through a county; in such counties the actual location of the urban population was determined so as to exclude towns and cities outside of the basin.

TABLE I. AREA AND POPULATION OF THE OHIO RIVER DRAINAGE BASIN BY STATES

State	Area		Population					
	In Ohio Basin, sq.mi.	Percentage of entire state	Rural	Percentage of total rural in state	Urban	Percentage of total urban in state	Total	Percentage of total in state
Alabama	6,842	13.3	249,742	14.1	32,835	8.9	282,577	13.2
Georgia	1,516	2.6	45,565	2.2	.....	0	45,565	1.8
Illinois	11,395	20.3	451,234	20.9	136,484	3.9	587,718	10.4
Indiana	29,292	81.6	1,311,466	84.2	860,091	75.3	2,171,557	80.5
Kentucky	38,859	97.1	1,676,905	96.9	544,215	98.1	2,221,120	97.1
Maryland	422	4.3	12,867	2.0	.....	0	12,867	1.0
Mississippi	397	0.9	12,241	0.8	.....	0	12,241	0.7
New York	1,889	4.0	71,499	3.7	51,832	0.7	123,331	1.4
North Carolina	6,105	12.6	209,372	11.1	21,580	6.8	230,952	10.5
Ohio	29,030	71.2	1,502,985	71.5	1,549,379	58.1	3,052,364	64.0
Pennsylvania	15,310	34.0	1,210,103	39.9	1,380,122	29.8	2,590,225	33.8
Tennessee	33,659	80.6	1,346,605	77.2	276,305	62.7	1,622,910	74.5
Virginia	7,222	18.0	306,089	19.3	23,627	5.0	329,716	15.9
West Virginia	21,083	85.7	907,269	91.5	211,177	92.6	1,118,446	91.6
Totals	203,021	34.6	9,313,942	37.6	5,087,647	22.2	14,401,589	30.2

Note: The percentages in the line of totals are percentages of the totals of all the 14 states.

TABLE II. AREA AND POPULATION OF THE OHIO RIVER DRAINAGE BASIN ABOVE DIFFERENT POINTS ON THE OHIO RIVER

Locality (above)	District below Pittsburgh miles	Area		Population					
		Sq.mi.	Percentage of total	Rural	Percentage of total rural	Urban	Percentage of total urban	Total	Percentage of total in basin
1. Junction of Allegheny and Monongahela Rivers	0	19,003	9.3	1,221,258	13.1	1,258,203	24.7	2,479,461	17.2
2. Penn.-Ohio State Line	39	23,308	11.5	1,552,489	16.7	1,625,855	32.0	3,178,344	22.1
3. Wheeling	90	24,803	12.2	1,677,900	18.0	1,688,264	33.2	3,366,164	23.4
4. Parkersburg	184	35,188	17.3	2,207,388	23.7	2,026,865	39.8	4,234,253	29.4
5. Below mouth of Little Kanawha River	184	37,667	18.5	2,305,939	24.8	2,044,707	40.2	4,350,646	30.2
6. Below mouth of Big Sandy River	317	60,322	29.7	3,252,581	34.9	2,192,674	43.1	5,455,255	37.8
7. Mouth of Little Miami River	463	70,322	34.6	3,713,144	39.9	2,524,303	49.6	6,237,447	43.3
8. Mouth of Great Miami River	489	75,990	37.4	4,007,823	43.0	3,069,411	60.3	7,077,234	49.1
9. Indiana-Ohio State Line	489	81,449	40.1	4,294,027	46.1	3,374,654	66.4	7,668,682	53.2
10. Louisville	602	90,584	44.6	4,671,362	50.2	3,453,720	68.0	8,125,082	56.4
11. Evansville	787	106,006	52.2	5,348,186	57.4	3,761,947	74.0	9,110,133	63.3
12. Below mouth of Wabash River	840	139,723	68.8	6,811,809	73.1	4,662,123	91.7	11,473,932	79.6
13. Paducah	924	202,055	99.5	9,266,554	99.5	5,054,586	99.4	14,321,140	99.5
14. Mouth	969	203,021	100.0	9,313,942	100.0	5,087,647	100.0	14,401,589	100.0

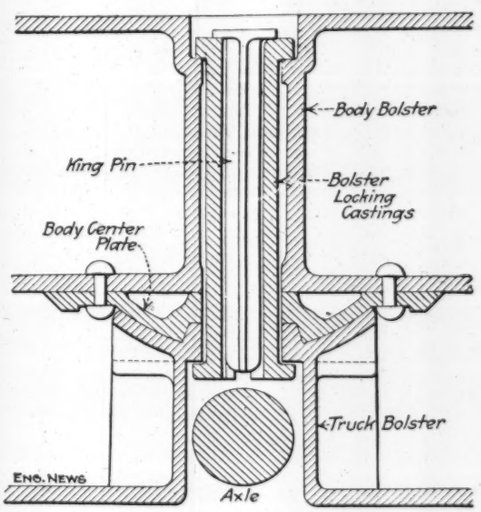
Note: No. 1 includes population of Pittsburgh; Nos. 3, 4, 10, 11 and 13 do not include the population of Wheeling, Parkersburg, Louisville, Evansville and Paducah respectively. No. 9 includes the Gr. Miami River; No. 13 includes the Cumberland and Tenn. Rivers.

drought be followed by a general rain which causes a rise of 5 to 10 ft. in the river and the dams in the river to be lowered, an immense amount of sewage and filth of every description along the entire length of the river would be swept into and down the river. Under such conditions it might be possible that even the flow of the river at the increased stage would be insufficient to produce the prescribed amount of dilution. After all, the question is not one of dilution to make the sewage inoffensive, but whether or not the untreated Ohio River water is suitable for a municipal water-supply; and no one, after examining Table II and reading the above discussion, would be willing to claim that the conclusions were not justified and to recommend the raw Ohio River water as a suitable water-supply for any town.

The need of legislation to control and limit the pollution of the Ohio River and tributaries is at once apparent and should be undertaken without delay. Legislation affecting so many states can only be prescribed by the federal government, for it is easily discernible that the problem is beyond the power of any one state, and that it would be practically impossible for a combination or association composed of all or part of the states in the Ohio River basin to arrive at any definite concerted action.

A Simple Device for Locking Passenger Car Bodies to Trucks

One of the causes of casualties in railway wrecks with ordinary passenger coaches is the ease with which the car body is pushed off the trucks and telescoped. Constant increase in the size and weight of car bodies has increased this tendency where the car bodies are held on



DEVICE FOR LOCKING CAR BODIES TO TRUCKS; GRAND TRUNK RY.

the trucks in the standard way with center plate and plain king bolt. The steel underframe of the modern car is sufficiently strong to stand heavy shock or impact with the buffing devices now commonly used, and if the car bodies are prevented from lifting and riding the platforms of adjoining cars, the danger of telescoping is greatly diminished.

With this end in view the Grand Trunk Ry. has recently adopted a simple device which is being applied to a number of new cars, and will hereafter be standard on all passenger equipment on the Grand Trunk Ry. lines. This device, shown in the accompanying illustration, consists of a steel key and ribbed pin in place of the ordinary, plain king bolt. The key is made of two sections of a hollow steel cylinder with flanges top and bottom. The flanges lock the truck frame to the car-body bolster, and the key is held in place by the ribbed king bolt, which is dropped into the cylindrical space within the key. This device does not interfere in any way with the free and flexible movement of the trucks, as provision has been made to give sufficient clearance, and the key may be removed with little more difficulty than an ordinary king bolt.

The locking device is the invention of J. Coleman, Superintendent of the Car Department, Grand Trunk Ry., to whom we are indebted for the foregoing description.

In a Rear End Collision on the Midland Ry., near Birmingham, England, on Jan. 13, two persons were killed and 40 injured.

Six Million Packages Were Handled by the Parcels Post during the first week after its installation, according to press reports.

Two Tunnel Explosions occurred at Chicago, on Jan. 14 and 15, in a branch water-supply tunnel, at about 72d St. and Cottage Grove Ave. Pockets of natural gas are considered as the cause of both accidents. The first occurred about 11:30 p.m., and three men were badly burned. The second occurred about 5 a.m., killing one man and injuring eight more. The tunnel is to supply Jackson Park and Washington Park. It extends from a pumping station at 58th St. and Cottage Grove Ave. to 73d St. and Drexel Ave., where it will connect with the Southwest tunnel of the city's water-supply system. It is expected to be completed next summer.

A Suit for Electrolytic Damage to a concrete building has been brought in the court of Lehigh County, Penn., by the Arbogast & Bastian Co., owner of a packing house in Allentown, Penn., against the Lehigh Valley Transit Co., which owns an electric power house within a few yards of the packing house. Suit has been brought to recover damages to the sum of $300,000 for the alleged damage to the building by stray electric currents from the power house. This is the building which was described extensively in "Engineering News," June 8, 1911, p. 684 and 1912, p. 149.

A Joint Water-Supply for the cities and towns of the Willamette Valley, Oregon, has been reported on for the State Board of Health by L. C. Kelsey, of Portland. It is estimated that a supply could be brought from Clear Lake, at the head of the Willamette River, for about $4,000,000. The pipeline would be 116 miles long, from 44 to 36 in. in diameter and would have a capacity, at its upper end, of 30,000,000 gal. Ten or dozen towns and a number of state institutions would be supplied. These towns include Salem, the state capital, whch is now supplied privately with water from a gravel bar in the Willamette River. State and municipal cooperation is proposed, but it appears that an issue of state bonds for this purpose might require a constitutional amendment, which could not be voted on until 1914.

A Very Large Mine Hoisting Engine is to be built for the Inverness Railway & Coal Co., of Cape Breton, Canada, by the Nordberg Manufacturing Co., of Milwaukee, Wis. The two cylinders are 34 in. in diameter with a 72-in. stroke, and the hoist has two drums, each equipped with clutches and post brakes enabling either drum to be operated independently. The hoist is designed to be able to lift the following load: A train of 12 mine cars, each of which weighs 1150 lb. and contains one long ton of coal. This train of cars has to be hauled up an incline 10,000 ft. in length, which has a slope of 16° at the surface and 35° at the bottom. The maximum stress on the hoisting cable is about 41,000 lb. The order was secured by the Nordberg Co. in competition with both German and English bidders.

A Very Large Reinforced-concrete Arch Bridge is being designed for the Chur-Arosa Ry., in Switzerland, to be known as the Langwiesen viaduct. It will have a main arch of 328.1 ft. calculated span, which will give a clear opening between skewbacks of 315 ft. This will be, if built as designed, somewhat smaller than the present largest concrete arch, the 328-ft. span across the Tiber. The bridge is being designed by E. Züblin & Co., Basel, Switzerland, under specifications approximately equivalent to those of the Swiss Reinforced-Concrete Committee.

The Mildness of the Present Winter in the eastern part of the United States in indicated by the fact that the Hudson River is still open for navigation to Albany. With the exception of the winter of 1889-90, when the river was not closed at all, but remained open from Mar. 10, 1889, to Dec. 2, 1890, this is the latest date the river has remained open in its history. Complete records dating back to 1824, are on record in the State Engineer's office, at Albany, and unofficial records before that time confirm the above statements. Only three times since 1824 has the closing of the river run over into the new year; in 1825, Jan. 5; in 1829, Jan. 14, and in 1882, Jan. 2. Generally navigation is stopped by Dec. 15. These data are based on the records of the New York State Engineer and Surveyor, and do not entirely agree with those of the U. S. Weather Bureau.

Severe Storms on the Atlantic during January, have done great damage to shipping. The Cunard liner "Mauretania" reached New York on Jan. 19, two days overdue. Her promenade deck shield was destroyed and her bridge damaged by a big wave on Jan. 15.

The steamship "El Dorado," of the Morgan Line, which sailed from Baltimore, Md., on Jan. 1, with a cargo of steel rails, for Galveston, Tex., has not been heard from and is thought to have gone down with her crew of 39 men in the storm of Jan. 3.

The Lamport & Holt Line Steamer "Veronese," sailing from Glasgow to Brazil, was wrecked off the coast of Portugal on Jan. 16.

The British steamer "Snowdon Range," which sailed from Philadelphia, on Nov. 23, bound for Leith, Scotland, docked at Queenstown on Jan. 14, after losing her rudder and drifting for seven weeks. The boat was sighted by the Dominion Liner "Welshman," about 500 miles out from Queenstown and towed into that port.

A Concrete Pile Test—In our issue of Dec. 19, 1912, page 1181, we noted the test of a very large reinforced-concrete column before a delegation from the National Association of Cement Users in the laboratory of the U. S. Bureau of Standards at Pittsburgh. On account of the very low ultimate value which this column reached, there has been considerable interest in the test, but it has not been generally understood that the test was in the nature of a spectacle for the visiting engineers rather than a complete investigation of the strength of a concrete column. As noted in our previous issue, the column was the largest reinforced-concrete column ever tested, being 30 in. in outside diameter with a 27-in. core within a helix reinforcement, which gave a total core area of 572.55 sq.in. The failing load was close to 2,000,000 lb., which in itself indicates the extraordinary size of the column as well as the value of the test as a spectacle. For the benefit of those who are in doubt as to the strength of the column, we would say that it was only 25 days old when tested, and that the concrete had not been protected from the time it was cast until it was broken, during which time the weather was closely approximately freezing. It is estimated from tests on other concrete made at about the same time that the value of the concrete at this age would hardly have exceeded 1400 lb. per sq.in. ultimate. No very complete log of the test was taken, but, as we stated before, the first sign of distress, which was the beginning of the spalling of the outside concrete, occurred at about 1500 lb. per sq.in. and the total load carried was 1,950,000, or about 3400 lb. per sq.in. core area.

Another Derailment of the Chicago Elevated Loop occurred Jan. 15, under very similar circumstances to that of the accident recorded in our issue of Jan. 16. As noted in the former article, two of the right-angle curves on the loop (with radii of 90 and 95 ft.) are intersected by grade crossings, making a complicated track arrangement and involving crossing-frogs of flat angles and the absence of superelevation on the curves. In the first accident, the rear trail car of a train was derailed at the crossing on the curve turning the corner from Van Buren St. into Fifth Ave. In the second accident the head car (a motor car) of a train of the Northwestern Elevated Ry., was derailed at the crossing on the curve turning the corner from Wabash Ave. into Van Buren St. Fortunately the train was running slowly, partly as the result of orders issued after the first accident. There was no great damage, but the tracks were blocked for some time, and South Side trains were unable to enter or leave the loop. It is proposed now to still further reduce the speed to 5 m. p. h. at the curves, and the management has suggested the use of steel girders as guard rails, extending some 4 ft. above the ties. These cou'd not be used at the crossings, however, and it is not clear how they would be attached to the structure. The main longitudinal girders are under the track, and apparently the only available supports are the tops of the columns carrying the transverse girders.

A Suspension Bridge of 2700-ft. span over the Mersey River, at Liverpool, England, was proposed by L. H. Chase, in a paper recently read before the Liverpool Engineering Society. The main dimensions of the proposed structure are given as follows, in the London "Times," Engineering Supplement, of Dec. 26: Main span, 2700 ft. long; towers, 500 ft. high; height above high-water mark, 200 ft.; depth of girders, 50 ft.; weight of girders, 2100 tons; width between girders, 50 ft.; width between towers 300 ft.; and weight of cables (410 sq.in. in each), 6400 tons. The total cost, exclusive of land and legal expenses, he thought should not exceed £825,000 (about $4,000,000).

The bridge is proposed only for automobile and street-car traffic. Instead of making long approaches on each shore a spiral incline was proposed, the spiral having an external diameter of 300 ft. and internal diameter of 200 ft., with a building occupying the space inside the helix.

United States Patents Expire with Foreign Patents notwithstanding the Brussels treaty of 1900, according to a decision of the U. S. Supreme Court announced on Jan. 20, 1913 (see note beginning "The Cameron Septic Tank Process Patent," immediately below.)

The Cameron Septic Tank Process Patent Expired in November, 1909, with the original British patent, according to a decision by the U. S. Supreme Court, announced Jan. 20, 1913, in a suit between the Cameron Septic Tank Co., of Chicago, and the city of Knoxville, Iowa. The company named maintained that the life of the patent (U. S. No. 634,423, to Cameron, Commin and Martin, Oct. 3, 1899) was extended to the full term of 17 years by an agreement covering all such cases reached on Dec. 15, 1900, by the International Conference for the Protection of Industrial Property, and subsequently ratified by the U. S. Senate (see "Eng. News," Oct. 14, 1909, p. 414, for a detailed statement of the company's claims, as made by H. D. Wyllie).

Presumably this decision will result in the termination of the suit brought in 1912 by the Cameron Septic Tank Co. against the city of Winchester, Ky., for infringement of the Cameron process patent on account of the construction by that city of an Imhoff or Emscher tank after designs by Chas. E. Collins, of Philadelphia.

There is now pending before the U. S. Court of Claims a suit brought by the Cameron Septic Tank Co. for the payment of royalties by the United States on account of septic tanks built by the War Department. The government, we understand, maintains that the Cameron patent, at least as regards the tanks built by it, is invalid, notwithstanding the decision of the U. S. Supreme Court affirming the process claims (but denying the apparatus claims), in the suit brought by the company against the village of Saratoga Springs, N. Y. (See "Eng. News," Jan. 23, 1908, pp. 88-91, for this decision; also Mar. 28, 1907, pp. 347-51, for decision of the lower court which declared the whole patent void, "for want of patentable invention"). So far as we can learn, no award for damages or royalties has ever been made in the Saratoga Springs case, although the court appointed a master to report on the subject as long ago as Feb. 20, 1908.

PERSONALS

Mr. U. E. Gillen, Superintendent of the Grand Trunk Ry., at Montreal, Que., has been promoted to be General Superintendent of the Western lines.

Mr. C. G. Bowker, Superintendent of the Grand Trunk Ry., at St. Thomas, Ont., has been promoted to be General Superintendent of the Eastern lines.

Mr. D. Crombie, Assistant to the Vice-President of the Grand Trunk Ry., at Montreal, Que., has been promoted to be General Superintendent of Transportation.

Mr. H. E. Whittenberger, formerly Superintendent of the Grand Trunk Ry., at Toronto, Ont., has been promoted to be

General Superintendent of the Ontario lines, the Toronto terminals and the Barrie division.

Mr. W. R. Cameron has resigned as City Engineer of Cairo, Ill. According to newspaper reports Mr. Cameron resigned because local political influences interfered with the proper performance of his work. He has accepted a position in St. Louis, Mo.

Mr. J. W. Knightlinger, recently Trainmaster of the Southern Pacific Ry., at Roseville, Calif., has been appointed Assistant Superintendent of the Louisiana Western R.R. and Morgan's Louisiana & Texas R.R. & Steamship Co., at New Orleans, La.

Mr. S. P. Waldron, M. Am. Soc. C. E., of New York City, has been appointed Contracting Manager of the Boston, Mass., office of the American Bridge Co., of New York, succeeding the late H. J. Kattell. Mr. Waldron's headquarters will be in the John Hancock Bldg., 120 Franklin St., Boston, Mass.

Mr. A. P. Prendergast, Division Superintendent of Motive Power of the Baltimore & Ohio Southwestern R.R., at Cincinnati, Ohio, has been transferred to Baltimore, Md., with the title of Superintendent of Motive Power of the entire eastern system, reporting directly to the General Manager of the eastern lines.

Mr. E. W. Sylvester, of Albany, N. Y., has been appointed Superintendent of Public Works, of Poughkeepsie, N. Y. Mr. Sylvester has been at different times First Assistant Engineer, New York State Highway Department, Assistant Engineer, New York State Barge Canal and the Albany city engineering department.

Mr. M. M. Worthington, a civil engineer, has been appointed City Manager of Sumter, S. C., succeeding Mr. Wm. F. Robertson, who was appointed as noted in our issue of Nov. 28, but resigned a short time later to accept a position in engineering work. Mr. Worthington has been with the Atlantic Coast Line R.R.

Mr. Walter G. Fox, formerly Engineer in charge of construction of the extension of the Mexican Southern Ry., has been appointed one of the Directors of Engineering and Construction of the Ferrocarril al Curaray, a new line being built by the government of Ecuador. Mr. Fox will have his headquarters at Ambato, Ecuador.

Dr. R. E. Doolittle, who has been acting Chief of the Bureau of Chemistry, U. S. Department of Agriculture, since the resignation of Dr. Harvey W. Wiley, has returned to his former position as Chemist for the appraisers, Customs Service, New York City. Dr. Carl Alsberg has been appointed Chief of the Bureau of Chemistry.

Mr. A. M. Lupfer, M. Am. Soc. C. E., of Spokane, Wash., has been appointed Chief Engineer of the Spokane, Portland & Seattle, the Oregon Trunk and the Spokane & Inland Empire Rys., with headquarters at Portland, Ore., succeeding Mr. Ralph Budd, resigned, as noted in our issue of Jan. 2. Mr. Lupfer was Chief Engineer of Spokane & Inland Empire Ry., three years ago.

Mr. M. J. McCarthy, formerly Assistant Superintendent of Motive Power of the Cleveland, Cincinnati, Chicago & St. Louis Ry., at Beech Grove, Ind., has been appointed Superintendent of Motive Power of the Baltimore & Ohio Southwestern R.R. and the Cincinnati, Hamilton & Dayton Ry., at Cincinnati, Ohio, succeeding Mr. A. P. Prendergast, transferred as noted elsewhere. According to the new organization of the Baltimore & Ohio R.R. mechanical department, Mr. McCarthy will report directly to the General Manager of the western lines.

Mr. S. Bruce McConnell, Assoc. M. Can. Soc. C. E., formerly Assistant Division Engineer of the Canadian Pacific Ry., at Montreal, Que., has been promoted to be Assistant Engineer. His headquarters will remain at Montreal. Mr. McConnell entered the railway service in 1898 as a transitman on location of the Midland Ry. of Nova Scotia. Later he was transitman and Resident Engineer on construction of the Great Northern Ry. of Canada, and Resident Engineer of a railway in Cuba. He joined the engineering staff of the Canadian Pacific in 1902, as Assistant Engineer in charge of yard construction at North Bay, Ont.

Mr. C. E. Allen, Assoc. Am. Inst. E. E., has been appointed Assistant Manager of the detail and supply department of the Westinghouse Electric & Manufacturing Co., East Pittsburgh, Penn. Mr. Allen graduated from the Virginia Polytechnic Institute in 1901. After graduation he entered the employ of the General Electric Co., at Schenectady, N. Y., as an apprentice. While with the General Electric Co., Mr. Allen was engaged for several years in transformer design, and he is the inventor of the distributed core type of transformer now made by the company. Mr. Allen entered the employ of the Westinghouse Electric & Manufacturing Co. in 1909, as the head of the transformer division of the detail and supply department.

Mr. F. W. Cappelen, M. Am. Soc. C. E., Chief Engineer and General Manager of the Decarie Incinerator Co., Minneapolis, Minn., has been made City Engineer of Minneapolis, succeeding Mr. Andrew Rinker. Mr. Cappelen is a Norwegian by birth. He was educated at the technical school at Orebro, Sweden, and the Polytechnicum, at Dresden, Germany, studying seven years in all. In 1880 he entered the service of the Northern Pacific Ry. as a draftsman, and a year later he was made Assistant Engineer in charge of location and construction work. For two years, 1884 to 1886, he was Bridge Engineer of the St. Paul & Northern Pacific Ry., at Minneapolis. From 1886 to 1892 he was Engineer of Bridges and Buildings of the city of Minneapolis; during this period he designed and built three large iron bridges over the Mississippi River. Mr. Cappelen was City Engineer of Minneapolis in 1892 and 1893.

Mr. Charles H. Moore, M. Am. Soc. C. E., has resigned as Principal Assistant Engineer of the Erie R.R., to accept the position of Director of Engineering and Construction of the Ferrocarril al Curaray, a railway being built by the government of Ecuador. Mr. Moore will remain in this country, his headquarters being at 33 Broadway, New York City, except when making an annual inspection of the work in Ecuador. Mr. Moore is a native of Baltimore, Md., and graduated from Lafayette College in 1884. He entered the railway service four years later as a rodman with the New York, Lake Erie & Western R.R. In 1890 he was made Resident Engineer of the Northern R.R. of New Jersey, and a year later Assistant Engineer of the New York, Lake Erie & Western R.R. Except for a year, 1893-94, when he was Assistant Engineer of the Quaker City & Northeastern Construction Co., of Philadelphia, Penn., Mr. Moore has been continuously in the service of the Erie R.R. He has been Consulting Engineer for the republic of Ecuador for a number of years.

The Pennsylvania R.R. has announced the following changes in the engineering department: Mr. W. R. Hillary, Division Engineer of the Lines West of Pittsburgh, Northwest system, has been promoted to be Supervising Engineer of the Central system, with headquarters at Toledo, Ohio; Mr. M. P. Tucker, Jr., has been appointed Division Engineer of the Akron division, Central system, at Akron, Ohio, vice Mr. R. C. Harris, promoted as noted in our issue of last week; Mr. A. C. Watson has been appointed Division Engineer of the Zanesville division, Central system, at Zanesville, Ohio, succeeding Mr. Tucker; Mr. J. A. Rothrock has been appointed Assistant Division Engineer at Zanesville, succeeding Mr. E. H. Kersting, transferred; Mr. R. C. Miller has been appointed Division Engineer of the Toledo division, Central system, with office at Toledo, Ohio, succeeding Mr. G. R. Barry, transferred to Logansport, Ind.; and Mr. R. R. Metheany, Jr., has been appointed Division Engineer of the Marietta division, Central system, at Cambridge, Ohio, succeeding Mr. S. W. Hodgin, transferred to Richmond, Ind.

OBITUARY

John Towne, formerly Contracting Manager of the American Bridge Co., for Maine, died at his home in Springfield, Mass., Jan. 12, aged 74 years. He was for many years Contracting Engineer of the Berlin Iron Bridge Co., of East Berlin, Conn.

John S. Spengler, Assistant Enginer of the Chicago Harbor and Subway Commission, and formerly Assistant City Engineer of Chicago, died Jan. 11. He was born at Bethlehem, Penn., in 1866, and began his engineering experience in railway work. He was at one time Assistant City Engineer at Memphis, Tenn., then an assistant engineer on the construction of the Chicago drainage canal, and then became connected with the Department of Public Works, in Chicago. He was a graduate of Lehigh University.

Francis Blake, inventor of the Blake transmitter, which had much to do in the development of telephony, died at his home in Weston, Mass., Jan. 19. He was born at Needham, Mass., on Christmas day, 1850. His education was received in the public schools of Brookline, Mass. For 13 years he served as a field officer of the United States Coast Survey. His invention of the Blake telephone transmitter in 1878, and of